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Taxonomy of Five Nearctic Subgenera of *Coelioxys* (Hymenoptera: Megachilidae)¹

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ABSTRACT

The taxonomy of five subgenera of *Coelioxys* which are restricted primarily to the North American continent are reviewed. The recognition of a surprising amount of infraspecific variation in many species allowed the synonymization of 64 names into 25 presumably valid species. The following species are described as new: *C. mitchelli*, *C. nodis*, *C. oaxacana*, and *C. serricaudata*. Keys are presented to the subgenera of North American *Coelioxys* and to species in the five subgenera treated herein. Distribution maps, host records where known, season of flight, a discussion of habitat where remarkable, of geographic variation where noticed and of comparative comments complete the description or redescription of each species in the five subgenera.

INTRODUCTION

Five of fourteen New World subgenera of bees in the genus *Coelioxys* are almost entirely confined to the North American continent. This paper concerns these five nearctic subgenera and is intended to complement a review of the New World subgenera of *Coelioxys* by Mitchell (1973) which set up 13 new subgenera. Therefore this paper may appear to be shallow in the diagnostic treatment at the subgeneric

level. Mitchell provides a thorough diagnosis of each subgenus, however, and it seems unnecessary to repeat such information here. Almost none of Mitchell's work is concerned with taxonomy at the species level.

Bees of the genus *Coelioxys* are so distinctive that since Latreille (1809) erected the genus, not a single bee now considered to be in *Coelioxys* has been described in another genus. So distinctive are these bees, in fact, that Dalla Torre and Friese (1894) set up the subfamily Coelioxinae based upon the genus *Coelioxys*. Cockerell and Robbins (1910) changed the spelling

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to *Coelioxynae*. The group was last given this rank by Hicks (1926). Robertson (1903), slightly more conservative, erected the tribe *Coelioxynini* but was the only and last (1929) person to use this rank for *Coelioxys*.

The genus *Coelioxys* shares certain characters with the genus *Megachile*: The notaulices are linear, arolia between the claws are lacking, and the basal metasomal tergum is shallowly concave anteriorly. *Megachile* and *Chalicodoma* are the most closely related genera. However, *Coelioxys* differs from them in that the metasoma has no scopa, the axilla is elongate, the pronotal tubercle is carinate, and the mesepisternum has an anterior and a lateral surface separated by a vertical carina. The metanotum and posterior surface of the scutellum are perpendicular, and the fore coxae of both sexes possess spines which are usually distinct. In general, *Coelioxys* species are black or very dark brown bees with white fasciae on the metasoma. The metasomas of females taper posteriorly, and the metasomas of males are denticulate or spinose apically. A character separating New World *Coelioxys* from all other New World megachilids is the presence of ocular hairs (however, the name *Coelioxys* does not mean "hairy eyes" as interpreted by Stephen, Bohart and Torchio (1969:54) but rather, according to Shuckard (1866), is derived from two Greek words, *kōilia* and *oxus*, which mean "acute abdomen").

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METHODS

Approximately 8,000 specimens were examined. Examination of type specimens was expedited by carrying a synoptic collection to various museums. Thus "homotypes" could be selected and later scrutinized at a more leisurely pace. When none of the specimens in the synoptic collection agreed (within a reasonable degree) with a type, notes describing the variation and photographs were made. Type specimens were run through the appropriate keys and compared with the appropriate descriptions so that all descriptions agree with all type specimens in each synonymy. After consideration of the general lack of reliability of the characters of hidden sterna and genital armature at the species level, a decision was made not to dissect out these parts of type specimens. At least these structures will be intact should a future systematist discover more stable characters than I have been able to find in these hidden segments.

Drawings of adults were made with the aid of an ocular grid except for the hidden sterna of males which were cleared in hot KOH, mounted on slides, and projected through a microscope for drawing. Use of an incandescent bulb in the illuminator of the binocular microscope seemed to be more effective than fluorescent lighting in the differentiation of dark brown areas of the integument.

Literature citations in the synonymies are restricted to articles in which synonymies were made and to biological studies. Extensive citations are given in a thesis by Baker (1972).

Characters are numbered throughout

each description in order to facilitate comparisons among species. To save space, references to characters of a species are deleted when they agree with the description of those characters for the first species treated in the group. Thus if a number does not appear in a description, that character agrees with the description of the first species in the group. Although this method may at first seem confusing, the value in space saved will undoubtedly outweigh the value of redundancy.

Flower records are given in a thesis by Baker (1972).

Host records and season of flight were taken from specimen labels (or from the literature, as noted).

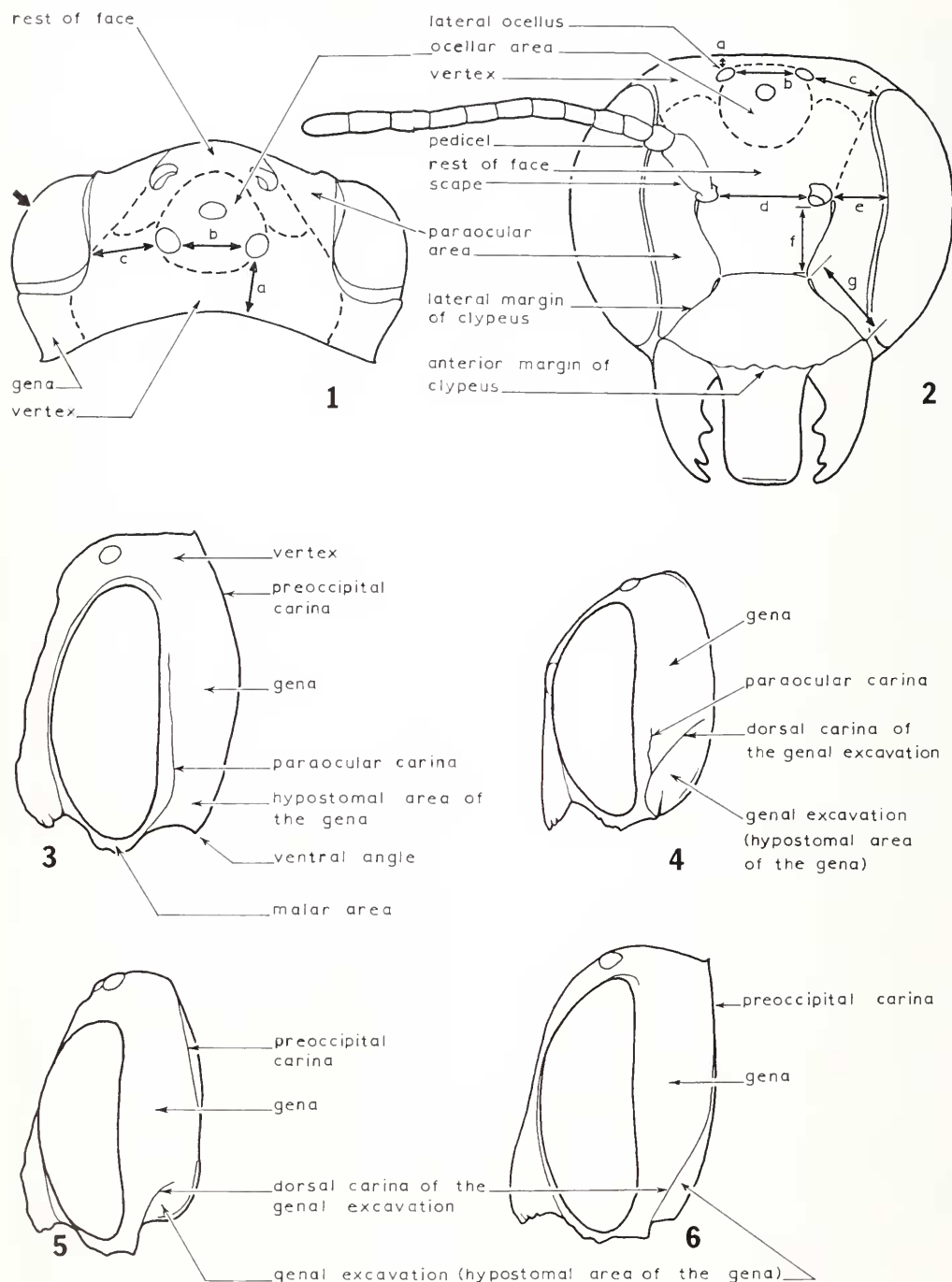
Küchler's (1964) map of potential vegetation types of the contiguous United States was used to try to find some correlation between species distributions and vegetation types. Many species extend through so many types that they appear to be distributed regardless of vegetation type. Some of the more restricted bees, however, seem to be associated with a group of vegetation types such as western coniferous forests or western shrub and grassland.

The distribution of any intraspecific variants noted was examined to see if there was a relation to geography. Size, color (of the legs especially), and crenulations of the sixth tergum in males, were all found to vary geographically in some species.

CHARACTERS

The following list enumerates characters found to vary among the species of the five subgenera of *Coelioxys* in this study. Explanatory comments are added wherever they seem to facilitate understanding. The Characters are numbered to correspond to the numbers used in descriptions (the first number for females, the second number for males).

(1, 24) LENGTH: measured in a dor-



FIGURES 1-6. 1, 2, Dorsal and frontal views of head of *Coelioxys texana* female (arrow, angle from which measurement of ocular hair made). a, ocelloccipital distance; b, interocellar distance; c, ocellocular distance; d, interantennal distance; e, antennocular distance; f, clypeoantennal distance; g, lateral margin of clypeus. 3-6. Lateral views of male *Coelioxys* heads. 3, *C. texana*; 4, *C. funeraria*; 5, *C. sodalis*; 6, *C. edita*.

sal view by an ocular scale in a binocular microscope. Length is the distance (in mm) from the bases of the antennae to the tip of the metasoma. By measuring from the bases of the antennae, compensation was made for specimens in which the normally hypognathous head is turned up to the prognathous position.

(2, 25) INTEGUMENT: punctuation and color.

(3, 26) PUBESCENCE: color, density, form. Pubescence of the tarsi is almost invariably golden.

(4, 27) OCULAR HAIRS: length. Ocular hairs are longest along the posterior margin of the compound eye. The measurement for all descriptions was made on the disc of the eye (Fig. 1) at the middle.

(5, 28) CLYPEUS: amount and type of pubescence, texture of integument, and conformation of the anterior margin.

(6, 29) CLYPEOANTENNAL DISTANCE AND THE LATERAL MARGIN OF THE CLYPEUS (*f* and *g* in Fig. 2): relative lengths.

(7, 30) PARAOCULAR AREA (Fig. 2): amount and type of pubescence (subject to wear), and integumental characters (when the integument is normally exposed in most specimens).

(8, 31) THE REST OF THE FACE (Fig. 2): pubescence, conformation, and punctuation.

(9, 32) THE CLYPEOANTENNAL, INTERANTENNAL, AND ANTENNOCULAR DISTANCES (*f*, *d*, and *e* in Fig. 2): relative lengths.

(10, 33) THE OCELLAR AREA (Figs. 1, 2, roughly equivalent to Mitchell's (1973) subocellar area): conformation.

(11, 34) OCELLOCCIPITAL, OCELLOCULAR, AND INTEROCULAR DISTANCES (*a*, *c*, and *b* in Figs. 1, 2): relative lengths.

(12, 35) VERTEX: punctuation and pubescence.

(13, 36) GENA: width in relation to the width of the eye (measured at the broadest part of both structures in lateral view).

(14, 37) HYPOSTOMAL AREA OF THE GENA: conformation, pubescence, angle of the posteroventral carina (the ventral angle). The hypostomal area of the gena varies greatly in pubescence and conformation between sexes among species and groups. This problem is most acute in males in which many times the ventral portion of the gena is deeply excavated. In *Coelioxys texana* the paraocular carina almost surrounds the eye and more or less defines the posterior margin of the malar area (Fig. 3). The gena sweeps from the vertex to the hypostomal carina without interruption. In *C. funeraria* a remnant of the paraocular carina remains posterior to the eye and another carina, the dorsal carina of the genal excavation, separates the gena from the genal excavation (Fig. 4). In *C. sodalis*, no remnant of the paraocular carina remains in the area of the gena (Fig. 5). In *C. edita* the dorsal carina of the genal excavation recurves dorsally where it merges with preoccipital carina (Fig. 6). In *C. rufitarsis* the condition of the genal excavation approximates that of *C. funeraria*.

(15, 38) MANDIBLE: conformation. Wear may give the mandibles a more robust appearance.

(16, 39) SCUTUM: punctuation and pubescence.

(17, 40) MESEPISTERNUM: pubescence and punctuation. The mesepisternum is divided into anterior and posterior surfaces by a distinct carina (Fig. 7). The lateral surface sometimes has minute punctures as well as larger punctures (Fig. 8). The anterior surface of the mesepisternum shows little variation throughout the five groups considered herein.

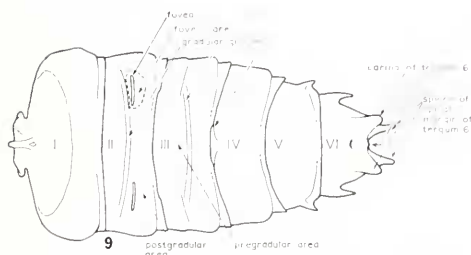
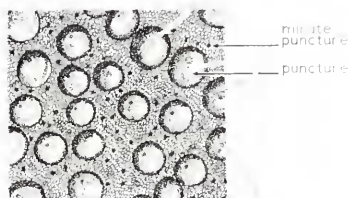
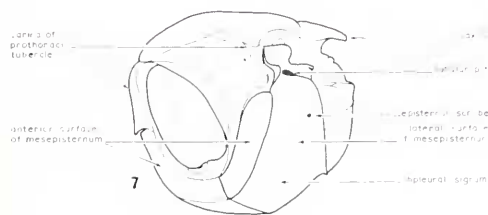
(18, 41) SCUTELLUM: punctuation, pubescence, and conformation of carina separating the dorsal and posterior surfaces in both dorsal and lateral views (Figs. 10 and 14 F).

(19, 42) AXILLA: length.

(20, 43) METANOTUM: pubescence.

(21, 44) FORE COXAL SPINE: shape, size, and the direction of protrusion.

(22, 45) METASOMAL TERGA: color, pubescence, punctuation, and the presence or absence of graduli and foveae (Fig. 9). The



FIGURES 7-9. Various *Coelioxys* parts. 7, Antero-lateral view of mesosoma of female *C. texana*; 8, Portion of integument of mesepisternum showing minute and larger punctures of female *C. texana*; 9, Dorsal view of metasoma of male of *C. rufitarsis*. Roman numerals indicate tergum numbers.

shapes of the apices of the sixth and seventh terga are sometimes specifically distinct (especially in males), and the general conformation of these segments is important at the subgeneric level.

(23, 46) EXPOSED METASOMAL STERNA: punctuation, pubescence, and conformation of the graduli. The apical margin of the sixth sternum of females displays a num-

ber of characters useful at the subgeneric and specific levels.

(47) HIDDEN STERNA AND GENITAL ARMATURE OF MALES: punctuation, pubescence, and conformation. These characters are useful at the subgeneric level but are of less use, if any, at the species level.

KEYS TO SUBGENERA OR SPECIES

The following keys separate species of North American *Coelioxys* into subgenera or species (for species not included in the five subgenera covered by this study). All *Coelioxys* species for which specimens were available from Mexico and northward are included.

Distribution is used as a character only in the two following keys, where species not otherwise treated in this paper can be separated by range. Careful taxonomic studies will have to be done before morphological characters are found to separate the members of several groups of similar species, and some species currently separated may be found to be synonymous. For example, the western forms *Coelioxys gilensis* and *C. deani* will probably be found synonymous when a systematic review is made of that group as will likely also be the case with *C. modesta* and *C. scitula*, two eastern forms. However, the morphological differences separating *C. gilensis* and *C. deani* from *C. modesta* and *C. scitula* are subtle, and the decision to recognize these four names as two or one species will be a difficult one. Distribution separates the two groups readily, although the separation may be an artificial one.

KEY TO FEMALES OF NORTH AMERICAN COELIOXYS.

1. Ocellar area (Figs. 1-2) swollen, impunctate 2
- Ocellar area not swollen or if raised then closely punctate. 8
2. Sixth metasomal sternum broadly rounded to acute apically, not notched subapically (Fig. 14A-D) *Synocoelioxys*

- Sixth metasomal sternum apically or subapically notched 3
3. Vertex between lateral ocellus and compound eye completely or almost impunctate, shining; scutellum almost impunctate medially, with a large, rounded projection posteriorly; sixth metasomal tergum blunt or truncate. 4
Vertex moderately to closely punctured; scutellum variously punctured, but with no projection; sixth metasomal tergum usually rounded 5
4. Wings blackish-brown; large bee (13-16 mm); southeastern United States *dolichos* Fox
Wings pale brown; medium sized bee (10-12 mm); Mexico and southward *laevigata* Smith, *laevis* Friese, *tolteca* Cresson
5. Scutellum impunctate medially or with scattered punctures, posterior margin of dorsal surface elevated 6
Scutellum closely, evenly and deeply punctured, posterior margin of dorsal surface not raised 7
6. Only basal metasomal tergum ferruginous across entire width; scutellum impunctate medially; Mexico and southward *assumptionis* Schrottky
Basal two or three metasomal terga ferruginous across entire widths; scutellum punctured medially; northern Mexico and northward *menthae* Cockerell
7. Thoracic and metasomal fasciae dense, conspicuous *slossoni arenicola* Crawford
Thoracic and metasomal fasciae narrow, inconspicuous *slossoni slossoni* Viereck
8. Sixth metasomal sternum notched subapically (as in Fig. 21) 9
Sixth metasomal sternum with margin entire 12
9. Scutellum without medioposterior projection 10
10. Scutellum with longitudinal, raised, impunctate line medially *mexicana* Cresson
Scutellum without raised, impunctate line medially 11
11. Metasomal terga two and three with graduli complete *Boreocoelioxys*
Metasomal terga two and three with graduli incomplete *Schizocoelioxys*
12. Sixth metasomal tergum and sternum attenuate apically, sixth sternum without conspicuous, erect subapical setae; Mexico and southward *zapoteca* Cresson
Sixth metasomal tergum and sternum variable but not conspicuously elongate, sixth sternum usually with erect subapical setae 13
13. Scutellum with posterior margin in dorsal view medially subangulate or with medioposterior projection; Mexico and southward 14
Scutellum with posterior margin in dorsal view gently rounded to straight .. 15
14. Scutum and axilla black *chichimeca* Crawford
Scutum and axilla with distinct ferruginous areas *gonaspis* Cockerell
15. Axilla with projecting portion as long as basal portion *obtusiventris* Crawford
Axilla with projecting portion about half as long as basal portion 16
16. Scutum and axilla with ferruginous areas; Mexico and southward *sanguinicollis* Friese
Scutum and axilla black; usually northern Mexico and northward 17
17. Sixth metasomal tergum in lateral view upturned apically 18
Sixth metasomal tergum in lateral view tapering horizontally 19
18. Metasoma with postgradular areas evenly punctured (one to two puncture widths between punctures) with small punctures; west of Rocky Mountains *deani* Cockerell, *gilensis* Cockerell
Metasoma with postgradular areas less closely punctured medially (four or five puncture widths between punctures) with medium sized punctures; east of Rocky Mountains *scitula* Cresson, *modesta* Smith
19. Prothoracic tubercle expanded into thin, plate-like structure *Xerocoelioxys*
Prothoracic tubercle with strong carina but not expanded into thin, plate-like structure *Coelioxys*
20. Eastern United States *germana* Cresson
Mexico and southward *totonaca* Cresson

KEY TO MALES OF NORTH AMERICAN COELIOXYS.

1. Ocellar area impunctate and swollen .. 2

- Ocellar area closely punctured or not swollen 9
2. Sixth metasomal tergum with dorsal spines modified into a crenulate plate (Fig. 12B-G) *Syncoelioxys*
Sixth metasomal tergum with two distinct dorsal spines (sometimes with a third median spine in specimens from Mexico and southward 3
3. Metasomal terga three to five with longitudinal, median ridge; vertex with scattered punctures; scutum practically impunctate on disc; scutellum impunctate medially with a large, rounded projection posteriorly 4
Metasomal terga three to five without longitudinal, median ridge; vertex variably punctured; scutum variably punctured; scutellum moderately to closely punctured, with or without large projection 5
4. Wings blackish-brown; large bee (10-14 mm); southeastern United States
..... *dolichos* Fox
Wings pale brown; medium sized bee (8-10 mm); Mexico and southward
..... *laevigata* Smith, *tolteca* Cresson
5. Vertex between lateral ocellus and eye impunctate; scutum, axilla, and scutellum with large ferruginous areas; scutellum with large, rounded posterior projection medially *azteca* Cresson
Vertex variously punctured; scutum, axillae usually black; scutellum without large, rounded posterior projection 6
6. Scutellum evenly, closely, deeply punctured on dorsal surface; carina separating dorsal and posterior surfaces incomplete laterally, only a small median portion raised above level of dorsal surface 7
Scutellum sparingly punctured or impunctate medially; carina separating dorsal and posterior surfaces entire, median half raised above level of dorsal surface 8
7. Thoracic and metasomal fasciae dense, conspicuous
..... *slossoni arenicola* Crawford
Thoracic and metasomal fasciae narrow, inconspicuous
..... *slossoni slossoni* Viereck
8. Only the basal metasomal tergum ferruginous across entire width
..... *assumptionis* Schrottky
- Basal two or three metasomal terga ferruginous across entire width
..... *menthae* Cockerell
9. Foveae (Figs. 9, 25B-H) on metasomal tergum two (in *C. mexicana* foveae may be very small on tergum two, but they are in an otherwise impunctate area) 10
Foveae not present or present on metasomal tergum three only 12
10. Foveae present on metasomal tergum three *mexicana* Cresson
Foveae absent on metasomal tergum three 11
11. Graduli complete on metasomal terga two and three *Boreocoelioxys*
Graduli incomplete medially on metasomal terga two and three
..... *Schizocoelioxys*
12. Foveae absent, foveal area may be closely punctured on metasomal terga two and three 13
Foveae present only on tergum three 17
13. Scutellum impunctate medially, posterior margin with flat, rounded projection
..... *azteca* Cresson
Scutellum punctured medially except sometimes for an impunctate longitudinal line, posterior margin variable 14
14. Scutellum in dorsal view with a conical projection posteriorly
..... *gonaspis* Cockerell
Scutellum in dorsal view without a projection 15
15. Metasomal tergum six with inner margins of dorsal spines forming a broad V
..... *zapoteca* Cresson
Metasomal tergum six with inner margins of dorsal spines forming a broad U 16
16. Thoracic and metasomal fasciae distinct; prothoracic tubercle produced into thin, plate-like structure; gradulus of tergum two curved toward apical margin medially *Xerocoelioxys*
Thoracic and sometimes metasomal fasciae inconspicuous; carina of prothoracic tubercle conspicuous but not expanded into thin, plate-like structure; gradulus of tergum two almost straight
..... *Coelioxys*
17. Posterior margin of scutellum in dorsal view with a median projection half as long as axilla 18

- Posterior margin of scutellum without median projection 19
18. Eastern United States .. *germana* Cresson
Mexico and southward
..... *totonaca* Cresson
19. Scutellum with narrow, impunctate, longitudinal median carina
..... *mexicana* Cresson
Scutellum without longitudinal median carina 20
20. Posterior margin of scutellum medially subangulate in dorsal view; basal metasomal terga with ferruginous areas; Mexico and southward
..... *chichimeca* Cresson
- Posterior margin of scutellum broadly rounded in dorsal view; metasoma black or very dark brown throughout; northern Mexico and northward 21
21. Metasoma with postgradular areas

closely and evenly punctured (maximum of one to two puncture widths between punctures) with small punctures; west of Rocky Mountains
..... *deani* Cockerell, *gilensis* Cockerell

Metasoma with postgradular areas less closely punctured medially (maximum of four to five puncture widths between punctures) with medium sized punctures; east of Rocky Mountains
..... *scitula* Cresson, *modesta* Smith

Subgenus *Synocoelioxys* Mitchell

Synocoelioxys Mitchell, 1973. A subgeneric revision of the genus *Coelioxys* of the Western Hemisphere. Cont. Dept. Entomol. North Carolina State Univ. p. 57. Type species: *Coelioxys texana* Cresson.

TABLE 1. Known host-parasite relationships for North American *Megachile* and *Coelioxys*. References to sources for species not covered by this review are given in footnotes. B = *Boreocoelioxys*, Co = *Coelioxys*, Cy = *Cyrtocoelioxys*, M = *Melanocoelioxys*, Sc = *Schizocoelioxys*, Sy = *Synocoelioxys*, X = *Xerocoelioxys*.

MEGACHILE and CHALICODOMA		COELIOXYS
Subgenus	species	species
Chelostomoides	campanulae	modesta (Cy) ³
Chelostomoides	subexilis	gilensis (Cy) ³
Delomegachile	frigida	funeraria (Sc), moesta (B), porterae (Co)
Delomegachile	melanophoea	rufitarsis (B), sodalis (Co)
Delomegachile	melanophoea wootoni	rufitarsis (B), sodalis (Co)
Eutricharaea	concinna	moesta (B)
Eutricharaea	rotundata	funeraria (Sc), gilensis (Cy) ⁴ , moesta (B), novomexicana (B), octodentata (B), sodalis (Co)
Litomegachile	brevis	novomexicana (B), octodentata (B), sayi (B)
Litomegachile	gentilis	novomexicana (B)
Litomegachile	mendica	octodentata (B), sayi (B)
Litomegachile	onobrychidis	octodentata (B)
Litomegachile	texana	octodentata (B), moesta (B), rufitarsis (B), sodalis (Co)
Megachile	centuncularis	modesta (Cy) ⁵ , moesta (B), octodentata (B)
Megachile	inermis	funeraria (Sc)
Megachile	montivaga	rufitarsis (B)
Megachile	relativa	funeraria (Sc), modesta (Cy) ⁶ , moesta (B), porterae (Co)
Megachiloides	umatillensis	mesae (X)
Melanosarus	xylocopoides	dolichos (M) ¹
Phenosarus	fortis	rufitarsis (B)
Pseudocentron	sidalceae	novomexicana (B)
Sayapis	polcaris	texana (Sy)
Sayapis	pugnata pugnata	alternata (Sy)
Xanthosarus	latimanus	funeraria (Sc), rufitarsis (B)
Xanthosarus	perihirta	grindeliae (X), octodentata (B), rufitarsis (B)

3. Krombein (1967).

4. From specimen labels in Washington, Canada.

5. Graenicher (1927).

6. Fye (1965).



FIGURE 10. Dorsal view of female *Cochioxys texana*, left half showing punctations, right half with melanization and pubescence added.

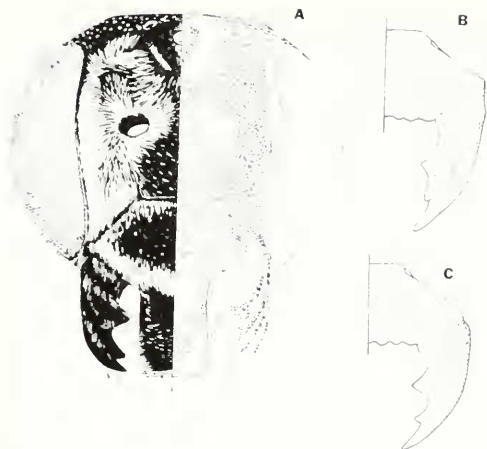


FIGURE 11. Frontal view of females of *Synocoelioxys*.

A, Head of *C. texana*. B-C, Left half of clypeus and mandible. B, *C. alternata*; C, *C. hunteri*.

Other bees in the subgenus *Synocoelioxys* are *C. alternata*, *C. apacheorum*, *C. hunteri*, and *C. erysimi*. This group of bees, although possessing many derived characters, possesses several characters which appear to be ances-

tral: the seventh sternum of males is complete, the sixth sternum of females has a simple margin and is not unduly lengthened, and the sixth tergum of males appears to be most ancestral (i.e. resembles most closely the condition found in some species of *Megachile* and *Liothyrapis*) of any of the New World *Coelioxys*.

Certain host bees are known for two species in *Synocoelioxys*: *Coelioxys texana* and *C. alternata*. Both utilize *Megachile* hosts of the subgenus *Sayapis* (Table 1).

Most of the characters in the list below are found in other subgenera of New World *Coelioxys* and even in some of the Old World *Liothyrapis*, but never in this combination. The simple seventh sternum and the crenulate margin of the sixth tergum of males are found in no other New World *Coelioxys*. Italicized characters most clearly differentiate *Synocoelioxys* from other subgenera in North America.

A. *Ocellar area raised, impunctate*. Median ocellus margined anteriorly by small group of anteriorly directed setae (Figs. 10, 11A, 12A).

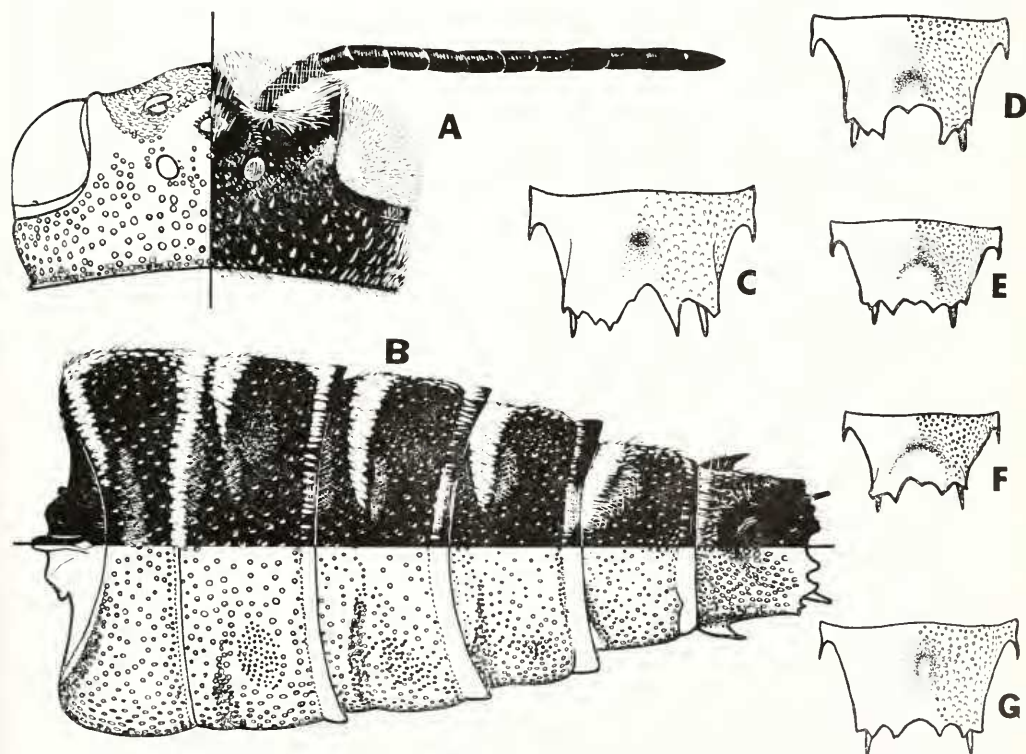


FIGURE 12. Dorsal views of males of *Synocoelioxys*. A-C, *C. texana*. A, Head; B, Metasoma; C, Sixth metasomal tergum. D-G, Sixth metasomal terga. D, *C. alternata*; E-F, *C. apacheorum*; G, *C. hunteri*.

B. Preoccipital carina complete medially (Fig. 3).

C. Mandible robust to slender (Fig. 11A-C).

D. Prothoracic tubercle with carina produced into thin plate-like structure.

E. Scutum moderately punctured (Fig. 10), fasciae indistinct to distinct.

F. Scutellum not flattened and usually without a projection although a small carina may be present (Fig. 14E).

G. Axilla well produced except in *Coelioxys alternata* (Figs. 10, 14E).

H. Mesepisternum moderately punctured, with minute punctures as well as larger punctures (Fig. 8).

I. Gradular grooves incomplete medially, becoming filled with squamose setae laterally (Figs. 10, 12B).

J. Female: front coxal spine variable but well produced in some species.

K. Female: lateral margin of sternum six

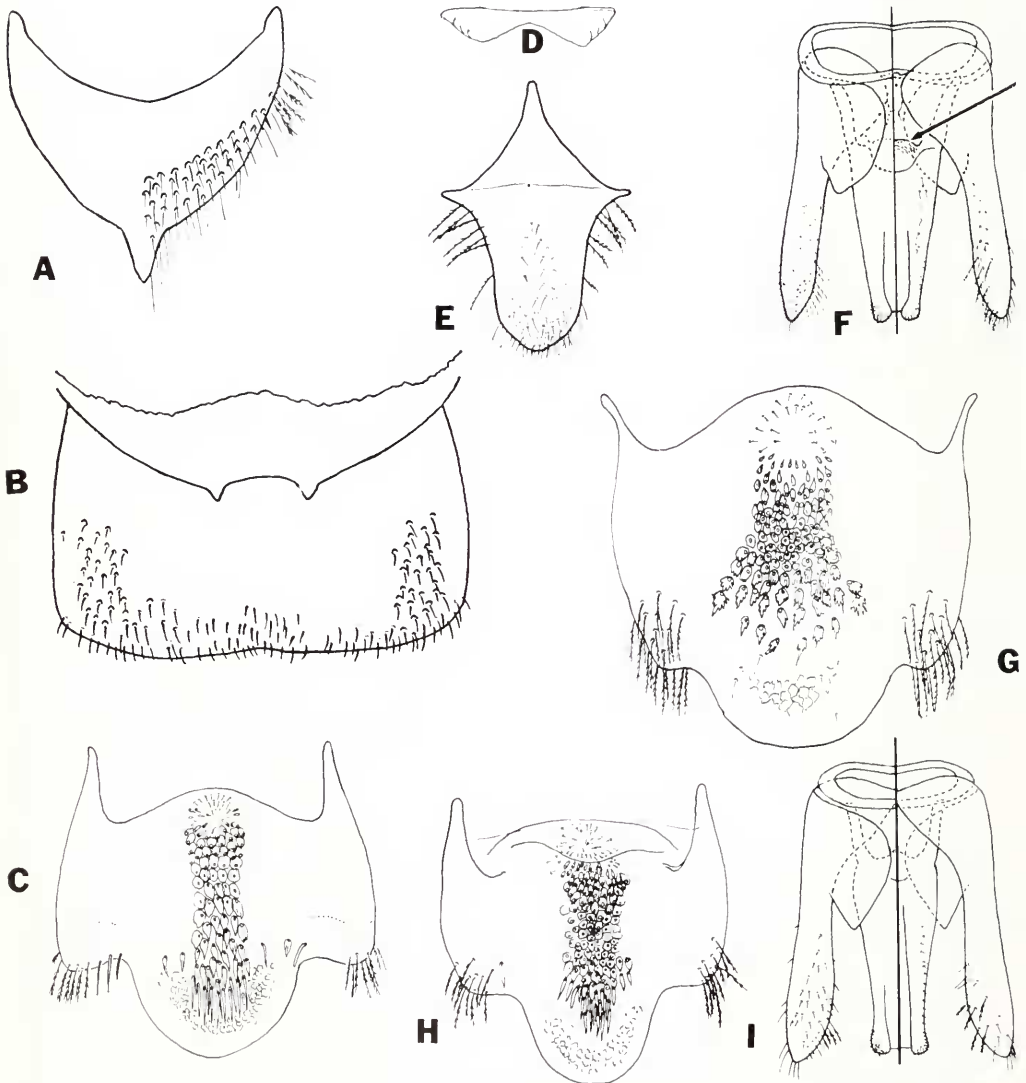


FIGURE 13. Hidden sclerites of males of *Synocoelioxys*. A-F, *C. texana*. A, Seventh tergum; B, Margin of fourth sternum, fifth sternum; C, Sixth sternum; D, Seventh sternum; E, Eighth sternum; F, Genital armature (arrow indicates rugulose area). G, Sixth sternum, *C. alternata*; H, Sixth sternum, *C. apacheorum*; I, Genital armature, *C. alternata*.

entire, acute or rounded apically (Figs. 10, 14A-C).

L. Male: hypostomal area of the gena not modified into excavation (Fig. 3).

M. Male: foveal area of tergum two sometimes very closely punctate (Fig. 12B).

N. Male: fifth tergum with lateral spine close to apical margin.

O. Male: carina of tergum six forming a crenulate plate (Fig. 12B-G).

P. Male: apex of tergum seven with a conspicuous spine (Fig. 13A).

Q. Male: apex of sternum four with a pair of teeth (Fig. 13B).

R. Male: sternum seven undivided, bilobed (Fig. 13D).

Key to Females of *Synocoelioxys*

1. Sixth sternum acute apically (or very narrowly rounded) (Fig. 14A, C) 2
Sixth sternum rounded apically (Figs. 10, 14B, D) 3
2. Axilla short (Fig. 14 E); mandible slender (Fig. 11B) *alternata*
Axilla longer (as in Fig. 10); mandible intermediate (Fig. 11C) *hunteri*
3. Lateral ocellus closer to occipital margin than to eye 4
Lateral ocellus equidistant from occipital margin and eye *texana*
4. Sternum six broadly rounded (Fig. 14D) *erysimi*
Sternum six more narrowly rounded (Fig. 14B) *apacheorum*

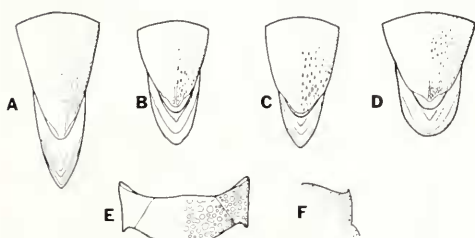


FIGURE 14. A-D, Sixth metasomal terga and sterna of females of *Synocoelioxys*. A, C, *alternata*; B, C, *apacheorum*; C, *C. hunteri*; D, *C. erysimi*. E-F, Dorsal (E) and optical section (F) of scutellum and axillae of *C. alternata*.

Key to Males of *Synocoelioxys*

1. Hypostomal area of the gena bare or with small slender setae which do not obscure integument 2

Hypostomal area of the gena obscured by setae at least as wide if not as long as setae on gena 3

2. Anterior portions of raised, impunctate ocellar area (Figs. 1, 2) separated by about one puncture width, usually a longitudinal row of punctures in the space; scutellum usually without a carina separating dorsal and posterior surfaces *hunteri*
Anterior portions of raised, impunctate ocellar area separated by about two or three puncture widths; scutellum usually with a carina separating dorsal and posterior surfaces (Fig. 14E) *alternata*
3. Ocellular distance less than ocellocapital distance; scape and pedicel usually ferruginous *texana*
Ocellular distance subequal to or greater than ocellocapital distance; scape and pedicel usually piceous or black 4
4. Posterior surface of scutellum with no appressed setae or a few slender appressed setae restricted to middle *erysimi*
Posterior surface of scutellum with squamose appressed setae across the full width *apacheorum*

Coelioxys texana Cresson

Figures 10, 11A, 12A-C, 13A-F, 15

Coelioxys texana Cresson, 1872, Trans. Amer. Entomol. Soc. 4:272 (♀, ♂ Texas, type ♀, in Philadelphia Academy of Sciences); Schwarz, 1896, Proc. Entomol. Soc. Washington 4:24 (Sleeping); Robertson, 1926, Psyche 33: 177 (Phenology); Krombein, 1967, Trap-nesting Wasps and Bees: Life Histories, Nests and Associates, Washington, D.C. 570 p.

Coelioxys texanus; Banks, 1902, J. New York Entomol. Soc. 10:212 (Sleeping).

Coelioxys texana sonorensis Cockerell, 1914, Entomologist 47:116 (♂, Sonora, Mexico, type in the National Museum of History) NEW SYNONYMY.

Coelioxys texana texana: Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:193, 194, 228 (Redescription, key).

FEMALE. (1) Length 9-14 mm; (2) integument between punctures granular on vertex, weakly so on thorax, dull on metanotum and propodeum, shiny elsewhere; black; scape, pedicel, apical portion of labrum, pronotal lobe, tegula, front coxal spine, trochanters, femora, tibiae, ventral or medioventral portion of hind coxa, lateroposterior margins of terga 1-4, sometimes 5, and posterior portions of sterna 1-5 ferruginous to reddish brown; (3) pubescence white, slightly brown below antenna, golden on tarsi, brown on apices of tergum 6 and sternum 6; (4) ocular hairs short (about 0.05 mm); (5) clypeus visible medially, margin irregular (Fig. 14A); (6) clypeoantennal distance subequal to lateral margin of clypeus; (7) paraocular area hidden laterally by setae about 0.2 mm long; (8) rest of face punctured up to ocellar area; (9) clypeoantennal and interantennal distances equal, greater than antennocular distance (Fig. 11A); (10) ocellar area with impunctate areas broad (Figs. 10, 11A); (11) ocelloloccipital distance subequal to ocellocular distance, greater than or subequal to interocellar distance (Fig. 10); (12) vertex moderately punctate (Figs. 10, 11A); (13) gena narrower than eye, setae not obscuring integument, ventral angle about 90° ; (14) hypostomal area of the gena with setae shorter than on disc; (15) mandible short, broad (Fig. 11A); (16) scutum with conspicuous fasciae (Fig. 10); (17) lateral surface of mesepisternum with punctures well separated, many more minute punctures than punctures, pubescence short; (18) scutellum with posterior margin of dorsal surface subangulate in dorsal view (Fig. 10); (19) axilla well produced (Fig. 10); (20) metanotal setae appressed medially, erect laterally; (21) front coxal spine subtriangular, flattened, directed ventrally or slightly forward, inconspicuous; (22) terga 1-5 with conspicuous fasciae, tergum 6 rounded (Fig. 10); (23) sterna 1-5

fasciate apically, fasciae less conspicuous posteriorly, punctures on sterna 1-4 with short setae, punctures exceedingly small and close medially on sternum 5 and subapically on sternum 6, ventral apical margin of sternum 6 bare, shining, broadly rounded (Fig. 10).

MALE. (24) Length 10-12.3 mm; (25) integument as in female (2 above); (26) pubescence white, golden on tarsi; (27) ocular hairs of medium length (about 0.075 mm, Fig. 12A); (28) clypeus hidden by setae in some specimens, coarsely rugose; clypeal margin as in female (5 above); (29) clypeoantennal distance as in female (6 above); (30) paraocular area hidden by setae about 0.3 mm long; (31) rest of face hidden up to ocellar area; (32) antennocular distance less than clypeoantennal distance which is less than interantennal distance; (33) ocellar area as in female (10 above); (34) interocellar and ocellocular distances equal, less than ocelloloccipital distance (Fig. 12A); (35) vertex as in female but longer (12 above, Fig. 12A); (36) gena as in female (13 above); (37) hypostomal area of the gena with setae as long as on discs; (38) mandible as in female (15 above); (39) scutum as in female (16 above) but with slender erect setae on disc; (40-43) mesepisternum, scutellum, axilla, metanotum as in female (17-20 above); (44) front coxal spine about twice as long as broad; (45) terga 1-6 fasciate, carina of tergum 6 crenulate, or with sharp denticles, deeply emarginate, often asymmetric (Fig. 12B-C), tergum 7 with apical spine (Fig. 13A); (46) sterna 1-4 evenly punctate with squamose setae filling most punctures, sterna 1-3 apically with irregular fasciae about 0.35 mm wide; (47) sternum 4 submarginally carinate, apex bidentate (Fig. 13B); margin of sternum 5 slightly emarginate (Fig. 13B); sternum 6 with unbranched setae medioapically (Fig. 13C); sternum 7 simple (Fig. 13D); sternum 8 with small,

unbranched setae medially (Fig. 13E); genital armature with area at base of penis valves (arrow on Fig. 13F) sometimes rugulose.

HOST RECORDS. Krombein (1967) reported rearing *Coelioxys texana* from trap nests provisioned by *Megachile polycaris*.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys texana* is most abundant in the southwestern United States (Fig. 15). Exceptionally long series have been taken at the Southwestern Research Station five miles west of Portal, Arizona.

This bee has been collected from March 27 to November 2 in Texas. One specimen of *Coelioxys texana* was taken November 17 at Ciudad Victoria, Tamaulipas, Mexico.

HABITAT. *Coelioxys texana* has

been taken at altitudes ranging from close to sea level (Indian Wells, California) to 9,000 feet. Habitats range from humid areas such as mangrove and floodplain forests of Florida to xeric habitats in Arizona and southern California where major vegetational types include *Larrea*, *Opuntia*, *Cercidium*, *Bouteloua*, *Hilaria*, *Quercus*, *Juniperus*, *Flourensia*, and *Fraseria*. *Coelioxys texana* is apparently not common at higher altitudes although specimens from two localities indicate it may range up into coniferous forests (Shannon Peak, Pinalena Mountains, Arizona, 9,000 feet and Madera Canyon, Santa Rita Mountains, Pima County, Arizona, 4,800 feet).

GEOGRAPHIC VARIATION. Specimens of *Coelioxys texana* from Florida have wings which are noticeably darker and a deeper yellow than wings of *C.*

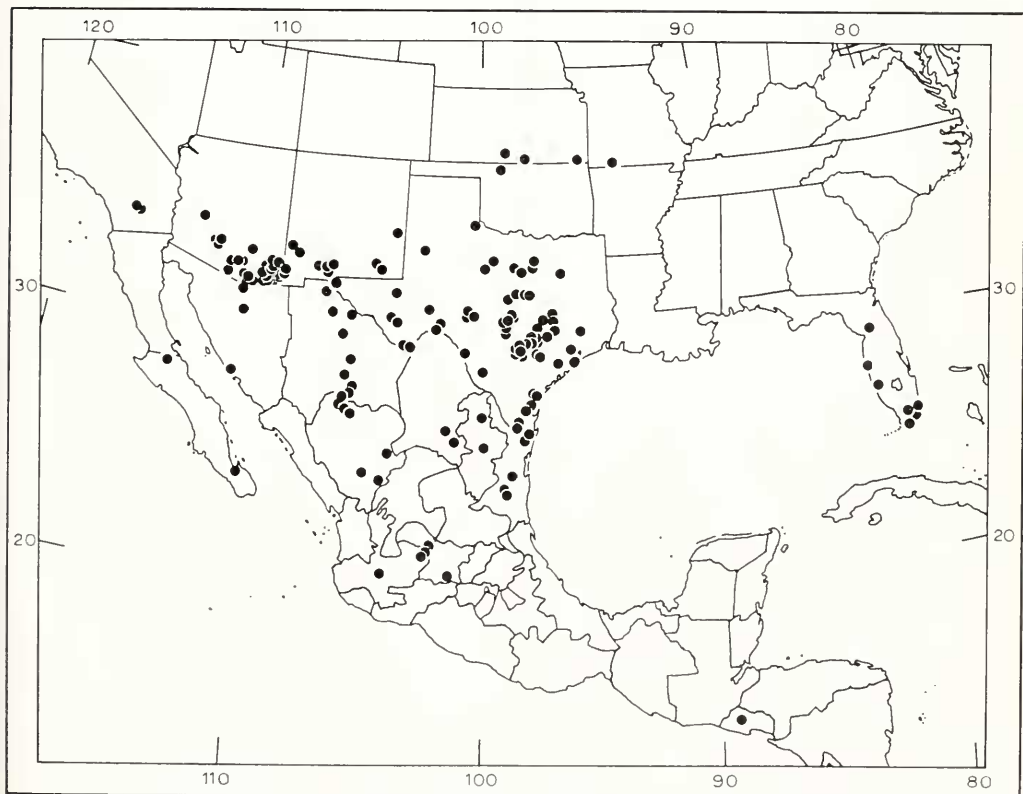


FIGURE 15. Distribution of *Coelioxys texana*.

texana from other areas. All (seven) males from Florida also have the margin of the carina of the sixth tergum produced into sharp denticles (Fig. 12 C); elsewhere the margin of the sixth tergum is crenulate (Fig. 12 B). A single female from the Lower Matecumbe Key with dark, yellowish wings (but typical in other characters) has been associated with these males.

COMPARATIVE COMMENTS. In both sexes of *Coelioxys texana* the antennal scape and pedicel are usually ferruginous, a condition found in no other North American *Coelioxys* spp. Of the females in this group, *C. texana* has the lateral ocelli furthest removed from the occipital margin (subequally distant from the occipital margin and eye).

Coelioxys alternata Say

Figures 11B; 12D; 13G, I; 14A, E-F; 16

Coelioxys alternata Say, 1837, Boston J. Natur. Hist. 1: 401 (♂, ♀, Indiana, type probably destroyed); Robertson, 1929, Flowers and Insects, Lancaster, Pennsylvania Sci. Press (Flower records); Graenicher, 1935, Ann. Entomol. Soc. Amer. 28:304; Medler, 1964, Can. Entomol. 96:918, 920, 921; Medler and Lussenhop, 1968, Univ. Wisconsin Research Bull. 274:51, 52 (Biology, key).

Coelioxys texana; Graenicher, 1911, Bull. Publ. Mus. Milwaukee 1:243 (Wisconsin, misidentification).

Coelioxys texana vegana Cockerell, 1912, Can. Entomol. 44:166, 169 (New Mexico, ♂, key, type in the American Museum of Natural History) NEW SYNONYMY.

Coelioxys cockerelli Crawford, 1915, Insecutor Inscitiae Menstruus 3:108 (♀, Colorado, type in the National Museum of Natural History) NEW SYNONYMY.

Coelioxys wisconsinensis Cockerell, 1925, Pan-Pacific Entomol. 1:145 (♀, ♂,

Wisconsin, type in the University of Colorado Museum) NEW SYNONYMY.

Coelioxys alternata alternata; Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:193-195 (Redescription, key).

Coelioxys alternata wisconsinensis; Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:193, 194, 196; Medler, 1964, Can. Entomol. 96:920, 921 (Host record).

FEMALE. Agrees with description and figures of *Coelioxys texana* except as follows: (1) Length 10-16 mm; (2) integument black or becoming dark reddish-brown to ferruginous on femora, tibiae, and metasoma; (3) pubescence white except golden on tarsi; (4) ocular hairs 0.08 mm long; (5) clypeus with setal fringe scant; (6) clypeoantennal distance shorter than lateral margin of clypeus; (7) parocular area rugose, almost hidden by 0.3-0.4 mm setae; (8) rest of face with median impunctate ridge; (9) antennocular distance subequal to clypeoantennal distance and to interantennal distance; (10) ocellar area with impunctate ridges not as conspicuous as those in Fig. 10; (11) interocellar distance greater than ocelloccipital distance and less than ocellocular distance; (12) vertex with longer, more copious setae than shown in Fig. 10; (13) gena with ventral angle acute, approaching 60°; (14) hypostomal area of the gena appearing bare; (15) mandible slender (Fig. 11B); (16) scutum with peripheral fasciae less conspicuous than shown in Fig. 10; thin setae on disc longer than shown in Fig. 10; (17) mesepisternum with lateral surface closely punctate, pubescence long and slender, lateral surface with as many or more punctures than minute punctures; (18) scutellum not angulate medially as seen from above, with carina separating surfaces (Fig. 14E, F); (19) axilla short (Fig. 14E); (21) front coxal spine re-

duced, sometimes slightly curved posteriorly; (22) terga 1-6 in general more slender than those of Fig. 10; (23) sterna 1-5 with apical fasciae of sparse hairs, punctures laterally with short, slender setae, punctures rather uniform throughout; sternum 6 acute apically (Fig. 14A), ventrad with punctures contiguous basally, in parallel rows.

MALE. Agrees with description and figures of *Coelioxys texana* except as follows: (25) integument as in female (2 above); (27) ocular hairs of medium length (about 0.1 mm); (28) clypeus hidden by setae in some specimens, coarsely punctured, shining when revealed; (29) clypeoantennal distance as in female (3 above); (30) paraocular area as in female (7 above); (31) rest of face with weak impunctate line to subocellar area; (32) clypeoantennal distance subequal to interantennal distance, greater than antennocular; (33) ocellar area as in female (10 above); (34) ocellocipital distance subequal to ocellocular distance and greater than interocellar distance; (35) vertex with more slender upright setae than shown in Fig. 12A; (36-42) gena, hypostomal area of the gena, mandible, scutum, mesepisternum, scutellum, axilla as in female (13-19 above); (43) metanotum with almost no appressed setae; (44) front coxal spine pointing ventrally, about as long as broad; (45) tergum 1 with median fascia not as complete as shown in Fig. 12 B, tergum 6 with carina denticulate (Fig. 12D), tergum 7 with apical projection slightly recurved, shorter than shown in Fig. 13A; (46) sterna 1-4 with apical fasciae interrupted medially, sternum 6 with a few slender scattered setae medioapically (Fig. 13G), genital armature with ventral lobe of gonocoxite acute apically (Fig. 13I).

HOST RECORDS. Medler (1964) reported rearing *Coelioxys alternata* from

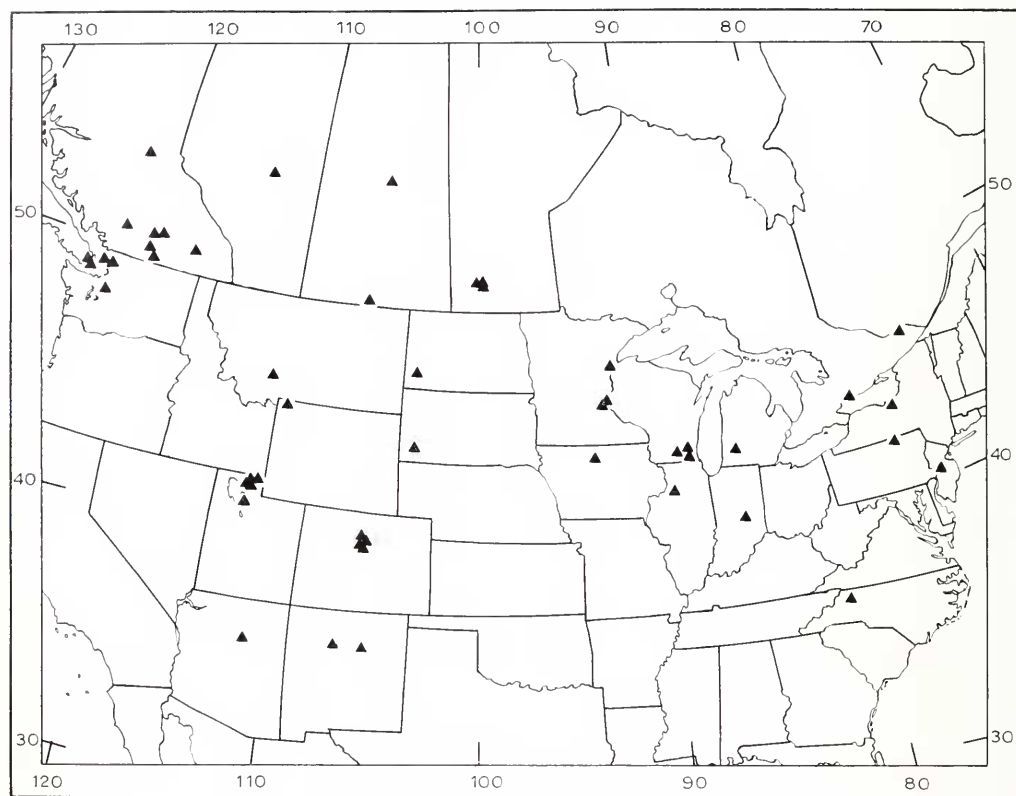
trap nests provisioned by *Megachile (Sayapis) pugnata pugnata*.

DISTRIBUTION AND SEASON IN FLIGHT. Although rare throughout its range, *Coelioxys alternata* occurs as far north as Edmonton, Alberta (Fig. 16). In the southernmost extensions of its range, *C. alternata* occurs only at higher elevations. One specimen from the American Museum of Natural History labeled "Tex. Collection Belfrage" is probably mislabeled. Somewhat surprising in view of its coast to coast distribution is a lack of specimens from California. The host bee, *Megachile pugnata pugnata* occurs as far west in California as the eastern sides of the Sacramento and San Joaquin Valleys.

Coelioxys alternata has been collected from June 24 to October 13.

HABITAT. Mesic conditions prevail throughout most of the localities from which *Coelioxys alternata* has been collected. Drier vegetational types include areas classified as bluestem prairie (*Andropogon*), oak savana (*Quercus*, *Andropogon*), and oak-juniper woodland (*Quercus*, *Juniperus*). Further north, *C. alternata* appears to be associated with various coniferous and hardwood forests.

GEOGRAPHIC VARIATION. Variation in *Coelioxys alternata* does not seem to be related to geography. The color of the legs and tegulae grades from black (previously considered to be *C. alternata wisconsinensis*) to ferruginous. Medler (1964) reared both black and ferruginous forms from the same domicile. Actually most specimens exhibit an intermediate condition, and all degrees of melanism are found throughout the range. The coexistence of forms with all degrees of melanism throughout the range, morphological agreement among forms, and identical host data were major factors contributing to the synonymizing of *C. alternata wisconsinensis* and *C. alternata alternata*.

FIGURE 16. Distribution of *Coelioxys alternata*.

COMPARATIVE COMMENTS.

Males of *Coelioxys alternata* are known from other males in *Synocoelioxys* (except *C. hunteri*) by the bare appearance of the hypostomal area of the gena. Unlike all other species of *Synocoelioxys*, the axillae in both sexes are usually very short (Fig. 14E). Females of *C. alternata* possess sixth sterna more acute apically (compare Figs. 14A and 14C) and mandibles more slender than those of *C. hunteri* (compare Figs. 11B and 11C).

Coelioxys apacheorum Cockerell

Figures 12E-F, 13H, 14B, 17

Coelioxys apacheorum Cockerell, 1900, Can. Entomol. 32:297, 299-307 (♀, New Mexico, key, type in the National Museum of Natural History); Linsley in Muesebeck *et al.*, 1951. Hymenoptera

of America North of Mexico; Synoptic Catalog USDA Agric. Mono. 2:1183 (= *fragariae*).

Coelioxys fragariae Cockerell, 1912, Can. Entomol. 44:167-169 (♂, California, key, type in the American Museum of Natural History); Cockerell, 1921, Amer. Mus. Novitates 21:3, 8-10 (Colorado, redescription).

Coelioxys quercina Cockerell, 1912, Can. Entomol. 44:167-169 (♂, Arizona, key, type in the American Museum of Natural History) NEW SYNONYMY.

FEMALE. Agrees with description and figures of *Coelioxys texana* except as follows: (1) Length 9-13 mm; (2) integument grainy on vertex, dull on thorax, shiny on abdomen; black; scape, front coxal spine, and coxae piceous; pronotal lobe and tegula dark brown to brown;

femora, tibiae and basitarsi dark brown to dark brown with ferruginous spots or segments to ferruginous throughout; latero-posterior margins of terga 1-4 and sometimes 5, and posterior margins of sterna 1-5 black to dark reddish-brown; (3) pubescence brown on apex of sternum 6; (4) ocular hairs 0.05-0.1 mm long; (5) margin of clypeus with 6 teeth about 0.05 mm long; clypeus sometimes with irregular impunctate line; (6) clypeoantennal distance shorter than lateral margin clypeus; (7) paraocular area hidden laterally by 0.2-0.3 mm setae; (8) rest of face with an indefinite impunctate line up to ocellar area; (9) clypeoantennal distance greater than antennocular distance and less than or subequal to interantennal distance; (10) ocellar area with arms of impunctate area medially separated by punctures in a band 2 or 3 punctures wide; impunctate area sometimes not as broad as in Figures 10, 11A; (11) ocellocipital distance less than or subequal to interocellar distance which is less than ocellocular distance; (12) vertex with slender erect setae longer than shown in Figure 10, especially in interocellar area; (13) gena with ventral angle slightly acute; (14) hypostomal area of gena with setae as long as or longer than on disc; (15) mandible with outer tooth longer than shown in Figure 11 A, more like Figure 11C; (16) scutum with erect setae longer and more copious than shown in Figure 10; (17) mesepisternum with lateral face closely punctate, more punctures than minute punctures, pubescence slender and long (about 0.35 mm); (18) scutellum with posterior margin of dorsal surface almost straight to broadly curved in dorsal view; (21) front coxal spine flattened and rounded apically, slightly recurved posteriorly, inconspicuous; (22) tergum 6 rounded apically (Fig. 14B); (23) sternum 6 moderately to narrowly rounded apically (Fig. 14B).

MALE. Agrees with description and

figures of *Coelioxys texana* except as follows: (24) Length 8.5-10.5 mm; (25) integument as in female (2 above); (27) ocular hairs 0.05-0.1 mm long; (28) clypeal margin and median line as in female (5 above); (29) clypeoantennal distance as in female (6 above); (32) clypeoantennal distance subequal to or greater than antennocular distance, less than interantennal distance; (33) ocellar area as in female (10 above); (34) ocellocular distance subequal to ocellocipital distance, greater than interocellar distance; (35) vertex with more erect, slender setae than shown in Figure 12A; (36) gena as in female (13 above); (37) hypostomal area of gena as in female (14 above); (39) scutum as in female (16 above); (40) lateral surface of mesepisternum closely but distinctly punctured, pubescence as in female (17 above); (41) scutellum as in female (18 above); (44) front coxal spine 1.5 times longer than wide; (45) terga 3-5 sometimes lacking apical fasciae medially or entirely, carina of tergum 6 with irregular denticulations (Fig. 12E, F); (46) sterna 1-4 evenly punctate with squamose setae filling most or only a few punctures, apically with irregular fasciae 0.25-0.3 mm (maximum) wide; (47) sternum 6 with lateral setae resembling *C. alternata* (Fig. 13H).

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys apacheorum* ranges from southwestern Canada to California and east to South Dakota, Colorado, and to the edge of the Edwards Plateau in Texas (Fig. 17).

Extremes of the flight period are April 10 (Abilene, Texas) and September 23 (Sequoia National Park, California) with the majority of specimens taken from June to August.

HABITAT. In its northern range, *Coelioxys apacheorum* is associated with areas classified as a variety of western coniferous forests, and one specimen was taken at the edge of alpine meadow west

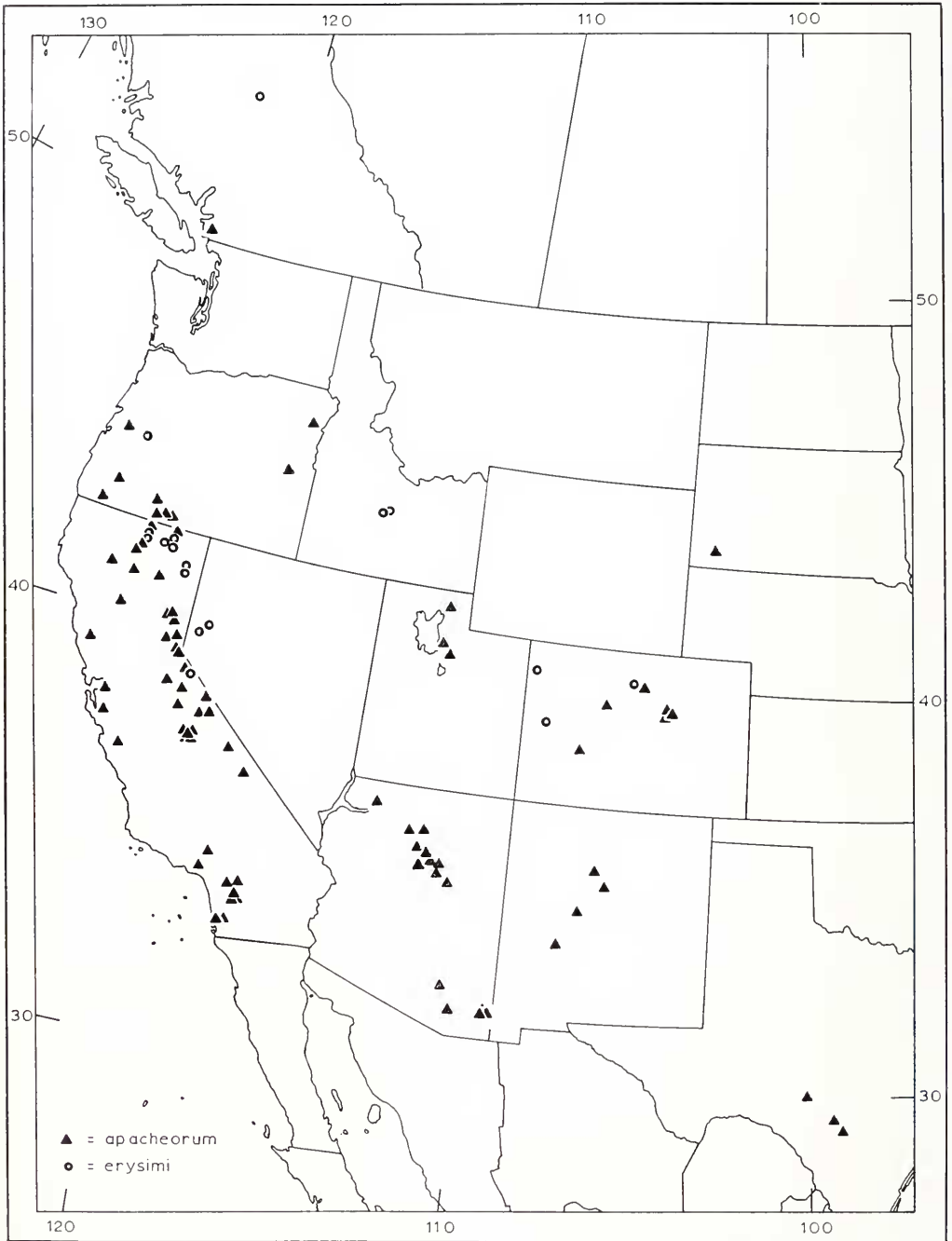


FIGURE 17. Distributions of *Coelioxys apacheorum* (Δ) and *C. erysimi*. (o).

of Boulder, Colorado. Further south the bee spreads into areas classified as western shrub and grassland and forest-grassland in Texas.

GEOGRAPHIC VARIATION. As with *Coelioxys alternata*, variation in *C. apacheorum* does not seem to be related to geography. Color of the legs varies

from black to ferruginous with an intermediate condition in which the tibia is dark medially with ferruginous proximal and distal areas. Bees exhibiting all degrees of melanism occur throughout the range.

The decision to synonymize *Coelioxys quercina* and *C. apacheorum* is based upon morphological agreement of the darker males (earlier associated with the females of *C. apacheorum*) with the lighter colored males which resemble the type of *C. quercina*.

COMPARATIVE COMMENTS. Specimens of *Coelioxys apacheorum* are usually smaller than the other species of *Synocoelioxys*. Dark males of *C. apacheorum* most closely resemble those of *C. erysimi* but have a fascia of squamose setae on the posterior surface of the scutellum. Dark females of *C. apacheorum* resemble females of *C. erysimi* and dark females of *C. alternata* but differ by the narrowly to moderately rounded sixth sterna (compare Fig. 14B and D).

Coelioxys erysimi Cockerell

Figures 14D, 17

Coelioxys erysimi Cockerell, 1912, Can. Entomol. 44:166 (♂ Colorado, type in the American Museum of Natural History).

FEMALE. Agrees with the figures and description of *Coelioxys texana* except as follows: (1) Length 12-14 mm; (2) integument black, sometimes piceous on tibiae; (3) pubescence white, sometimes brownish below antennae, pale brown on apices of tergum 6 and sternum 6; (4) ocular hairs of medium length (about 0.08 mm); (5) clypeus with fringe of setae shorter than shown in Figure 11; (6) clypeoantennal distance shorter than lateral margin of clypeus; (7) lateral quarter of paraocular area hidden by setae, erect setae about 0.3 mm long; (8) rest of face with an indistinct impunctate median line;

(9) interantennal distance slightly greater than clypeoantennal distance which is greater than antennocular distance; (11) interocellar distance slightly greater than ocelloccipital distance and less than ocellocular distance; (14) hypostomal area of gena with setae as long or longer than on disc; (15) mandible with apical tooth longer than shown in Figure 11A, more like Figure 11C; (16) fasciae of scutum not as distinct as shown in Figure 10; (17) mesepisternum with lateral surface closely punctate, many more punctures than minute punctures, pubescence long (about 0.35 mm) and slender; (18) scutellum with posterior margin of dorsal surface broadly rounded; (19) axilla shorter than shown in Figure 10, longer than shown in Figure 14E; (20) metanotum with small amount of setae appressed medially; (21) front coxal spine with anterior surface 1.5 times as long as wide, small but conspicuous; (22) terga 1-5 with gradular fasciae inconspicuous; (23) sterna 1-5 with irregular fasciae.

MALE. Agrees with the figures and description of *Coelioxys texana* except as follows: (24) Length 10-12.5 mm; (25) integument as in female (2 above); (27) ocular hairs as in female (4 above); (28) clypeal margin as in female (5 above); (29) clypeoantennal distance as in female (6 above); (30) paraocular area hidden by setae about 0.4 mm long; (34) interocellar distance equal to or less than ocellocular distance, less than ocelloccipital distance; (38) mandible as in female (15 above); (36) scutal fasciae indistinct or lacking; (40-42) mesepisternum, scutellum, axilla as in female (17-19 above); (43) metanotum with little or no appressed setae medially; (45) tergum 2 with median portion of gradular groove bare, carina of tergum 6 denticulate, apical spine of tergum 7 shorter than shown in Figure 13A; (46) setae filling punctures of sterna 1-4 not squamose.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys erysimi* is probably restricted to the higher elevations of the western United States and Canada (Fig. 17). Judging from the small number of specimens examined, this bee appears to be rare throughout its distribution.

This bee has been taken between June 21 and September 9.

HABITAT. *Coelioxys erysimi* has been taken from areas classified as grand fir-Douglas fir (*Abies-Pseudotsuga*) and pine-Douglas fir (*Pinus-Pseudotsuga*) forests, from juniper-pinyon and juniper-steppe woodland (*Juniperus*, *Pinus*, *Artemisia*, *Agropyron*), from Montane chaparral (*Arctostaphylos*, *Castanopsis*, *Ceanothus*), and from Great Basin sagebrush and sagebrush steppe (*Artemisia*, *Agropyron*) vegetation types.

GEOGRAPHIC VARIATION. Variation within *Coelioxys erysimi* does not seem to be related to geography.

COMPARATIVE COMMENTS. *Coelioxys erysimi* is variable in size but seems to be invariably dark (black or piceous) throughout. Females most closely resemble dark females of *C. apacheorum* but the sixth sternum is as broad as that of *C. texana* (compare Figs. 10 and 14D). Males of *C. erysimi* are distinguished from dark males of *C. apacheorum* by the lack of a fascia across the posterior area of the scutellum.

Coelioxys hunteri Crawford

Figures 11C, 12G, 14C, 18

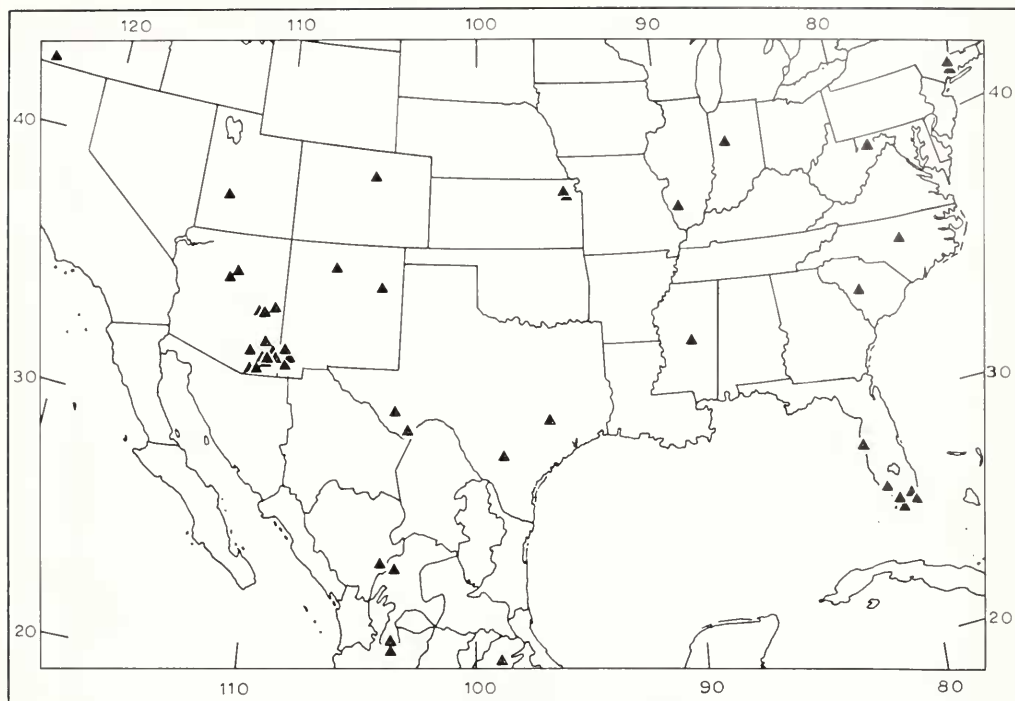
Coelioxys hunteri Crawford, 1914, Ann. Entomol. Soc. Amer. 7:151 (♀, Texas, type in the National Museum of Natural History); Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:193, 209 (Key, redescription).

FEMALE. Agrees with figures and description of *Coelioxys texana* except as follows: (1) Length 10.5-13.5 mm; (2) integument with scape, legs and metasoma

darker than ferruginous, scape and metasoma sometimes black; (5) clypeus medially with slightly raised impunctate line, apically with 0.1 mm fringe of slender setae barely obscuring margin, medioapically with 5-10 setae 0.2-0.3 mm long; (6) clypeoantennal distance shorter than lateral margin of clypeus; (7) lateral third of paraocular area hidden by setae, medial area visible between erect setae; (8) rest of face closely punctate except for slightly raised median line; (11) interocellar and ocelloccipital distances equal, greater than ocellocular distance; (15) mandible more slender than Figure 11A (Fig. 11C); (17) lateral surface of mesepisternum with about as many or more punctures than minute punctures; (21) front coxal spine rounded in frontal view; (22) tergum 6 narrowly rounded apically (Fig. 14C); (23) sternum 6 acute apically (Fig. 14C).

MALE. Agrees with figures and description of *Coelioxys texana* except as follows: (24) Length 10-12.5 mm; (25) integument as in female (2 above); (29) clypeoantennal distance as in female (5 above); (30) paraocular area hidden except for small inner area by setae 0.4 mm long; (34) interocellar distance less than ocellocular distance which is less than ocelloccipital distance; (37) hypostomal area of gena with setae much shorter than genal setae; (38) mandible as in female (15 above); (40) mesepisternum as in female (17 above); (45) carina of tergum 6 crenulate or more commonly denticulate, asymmetrical (Fig. 12G) tergum 7 with apical projection slightly more attenuate than shown in Figure 13A.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys hunteri* has a range similar to that of *C. texana* except *C. hunteri* has been taken further north (Fig. 18). As with *C. texana*, the longest series has been taken in the vicinity of the Southwestern Research Station five miles west of Portal, Arizona.

FIGURE 18. Distribution of *Coelioxys hunteri*.

Coelioxys hunteri has been taken from March 14 (Florida) to September 18 (Oregon).

HABITAT. *Coelioxys hunteri* extends through a wide variety of vegetation types in the United States. In the West, it is associated with areas classified as fir-hemlock (*Abies-Tsuga*), pine-spruce (*Pinus-Picea*), juniper-pinyon (*Juniperus-Pinus*) forests as well as western shrub (*Atriplex-Sarcobatus*) and shrub-grassland (*Bouteloua, Hilaria, Larrea*) vegetation types. In the central United States, *C. hunteri* has been collected in shinnery (*Quercus-Andropogon*), bluestem prairie (*Andropogon, Panicum, Sorghastrum*), and oak-hickory (*Quercus-Carya*) vegetation types. Further east, it extends from the northern hardwood forests down to marl-everglades (*Mariscus* and *Persea, Taxodium*), subtropical-pine (*Pinus-Tetrazgyia*), and mangrove (*Avicennia-Rhizophora*) vegetation types.

GEOGRAPHIC VARIATION. Size, using head width of males as an index, was found to vary geographically in *Coelioxys hunteri* (Females were not used in this study because sample sizes from the eastern United States were too small to yield meaningful results). Head widths of nine males from Florida (3.64 ± 0.133 mm) were significantly larger than those of 15 males from the rest of the eastern United States (3.48 ± 0.130 mm) or 109 males from Southern California, Arizona, New Mexico, western Texas and Mexico (3.38 ± 0.144).

COMPARATIVE COMMENTS. *Coelioxys hunteri*, a medium to large bee, most closely resembles *C. texana* but differs in the males by the bare appearance of the hypostomal area and in the females by the apically very narrowly rounded sixth sternum. Also in the males of *C. hunteri*, the lateral ocellus is subequally distant from the eye and occipital margin,

whereas in *C. texana* the lateral ocellus is closer to the eye than to the occipital margin.

Subgenus *Schizocoelioxys* Mitchell

Schizocoelioxys Mitchell, 1973. A subgeneric revision of the genus *Coelioxys* of the Western Hemisphere. Cont. Dept. Entomol. North Carolina State Univ. p. 50. Type species: *Coelioxys funeraria* Smith.

Coelioxys funeraria is the lone New World representative of an Old World group of bees (Mitchell, 1973). The lateral widening of the apical fascia on the first metasomal tergum as well as the medial obliteration of the metasomal graduli is characteristic of many Old World *Coelioxys* spp. Host records of *C. funeraria* fall into four subgenera of *Megachile* (Table 1). Two host subgenera, *Eutricharaea* and *Megachile*, are Holarctic in distribution (the first by recent introduction); and the other two host subgenera, *Delomegachile* and *Xanthosarus*, are closely resembled by two Palearctic groups (Mitchell, personal communication). One of the five known hosts of *C. funeraria* has had only *C. funeraria* reported as a parasite: *M. inermis*. The other four bees are exploited by one to three other species of *Coelioxys*. This bee seems to be a more generalized parasite than the endemic groups of North American *Coelioxys* such as *Boreocoelioxys* and *Synocoelioxys*. The host range and resemblance of *C. funeraria* to Palearctic species suggest that this bee may be a fairly late arrival on the North American scene.

Schizocoelioxys is distinguished from other subgenera of *Coelioxys* by the following list of characters. The absence of fasciae on the scutum and the hump on the inner surface of the mandible (Fig. 22A) are found in no other species of North American *Coelioxys*. Italicized characters most clearly differentiate *Schizocoelioxys* from other subgenera in North America.

- A. Ocellar area closely punctured.
- B. Preoccipital carina incomplete.
- C. Mandible with hump on inner surface (Fig. 22A).
- D. Prothoracic tubercle with carina moderately produced.
- E. Scutum moderately punctured, lacking fasciae.

F. Scutellum moderately punctured (Fig. 23A).

G. Axilla short (Fig. 23A).

H. Mesepisternum moderately punctured with a few minute punctures in female, contiguously punctured in male.

I. Metasomal terga with graduli incomplete medially.

J. Female: fore coxal spine carinate, blending with medioanterior surface of coxa.

K. Female: sixth metasomal sternum elongate and notched (Fig. 24A).

L. Male: hypostomal area of gena with excavation bare, shining (Fig. 4).

M. Male: conspicuous fovea on metasomal tergum two.

N. Male: spine reduced but present on metasomal tergum five.

O. Male: sixth metasomal tergum with conspicuous spines (Fig. 25A).

P. Male: apex of tergum six rounded apically (Fig. 19A).

Q. Male: sternum four emarginate apically (Fig. 19B).

R. Male: sternum seven represented by two small sclerites (Fig. 19D).

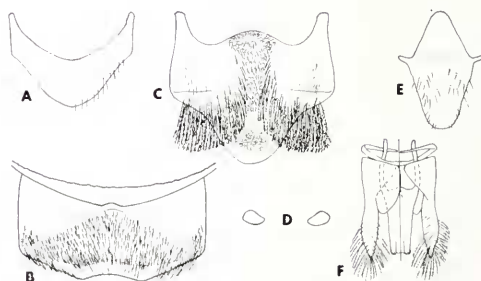


FIGURE 19. Hidden sclerites of male of *Coelioxys funeraria*. A, Seventh tergum; B, Margin of fourth sternum, fifth sternum; C, Sixth sternum; D, Seventh sternum (represented by two sclerites); E, Eighth sternum; F, Genital armature.

Coelioxys funeraria Smith Figures 19A-F, 20, 22A, 25A-B

Coelioxys funeraria Smith, 1854, Catalogue of British Hymenoptera in the collection of the British Museum I: 272 (♂, Canada, type in the British Museum); Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152: 195, 203 (Key, redescription, = *C. latralis* Cresson, = *C. lucrosa* Cresson);

Hobbs, 1968, Can. Entomol. 100: 783 (Host).

Coelioxys lateralis Cresson, 1864, Proc. Entomol. Soc. Philadelphia 2:405 (♂, Pennsylvania, type # 2498 in Academy of Natural Sciences of Philadelphia).

Coelioxys lucrosa Cresson, 1878, Trans. Amer. Entomol. Soc. 7:97 (♀, New York, Colorado, type # 2496 in Academy of Natural Sciences of Philadelphia); Graenicher, 1905, Bull. Natur. Hist. Soc. Wisconsin 3:160 (Biology); Graenicher, 1927, Entomol. News 38: 233 (Biology); Graenicher, 1935, Ann. Entomol. Soc. Amer. 28:300, 304 (Biology); Medler, 1958, Can. Entomol. 90: 326-327 (Biology); Medler and Koerber, 1958, Ann. Entomol. Soc. Amer. 51:343 (Biology).

Coelioxys hicksi Cockerell, 1934, Amer. Mus. Novitates 732:3 (♀, Colorado, type in the American Museum of Natural History) NEW SYNONYMY.

FEMALE. (1) Length 12-16 mm; (2) integument finely rugulose between punctures, dull on propodeum; black to very dark brown; (3) pubescence white to light golden brown, golden on tarsi; (4) ocular hairs of medium length (about 0.05 mm); (5) clypeus visible medially, slightly convex, closely punctured with small (about 0.018 mm) punctures; margin gently out-curved, with 5 small denticulations (Fig. 22A); (6) clypeoantennal distance less than lateral margin of clypeus; (7) paraocular area visible between 0.35 mm long setae, closely punctured; (8) rest of face closely punctured up to ocellar area except for longitudinal median area indented by a longitudinal median line; (9) interantennal distance greater than clypeoantennal distance which is greater than antennocular distance; (10) ocellar area sloping, coarsely punctured; (11) interocellar distance greater than ocellocipital distance, less than ocellocular distance; (12) vertex with punctures slightly larger and

slightly more crowded than shown in Figure 10; (13) gena subequal in width to eye, tapering dorsally and ventrally; (14) hypostomal area of gena with setae slightly longer than on gena; (15) mandible with a distinct hump on inner surface (Fig. 22A); (16) scutum with inconspicuous, slender setae; median line extending slightly more than half the distance from anterior margin; disc less closely punctured than periphery; (17) lateral surface of mesepisternum punctured like scutum in Figure 10, but with a few minute punctures among punctures; (18) scutellum with posterior margin of dorsal surface broadly rounded in dorsal view (Fig. 23A); (19) axilla reduced in length (Fig. 23A); (20) metanotum with inconspicuous, long, slender setae; (21) front coxal spine a thickened carina blending with medioanterior surface of coxa; (22) terga 1-5 with graduli incomplete medially, with apical fasciae wider laterally; graduli bare; tergum 6 elongate with raised, impunctate median line (Fig. 24A); (23) sterna 1-5 fasciate apically; 1-4 more closely punctured laterally; sternum 5 very closely and minutely punctured apically; sternum 6 minutely and closely punctured with elongate punctures, elongate, notched subapically (Fig. 24A).

MALE. (24) Length 9-12 mm; (25) integument as in female (2 above); (26) pubescence as in female (3 above); (27) ocular hairs of medium length (about 0.08 mm); (28) clypeus and clypeal margin hidden by setae 0.5 mm long, conformation as in female (5 above); (29) clypeoantennal distance shorter than lateral margin of clypeus; (30) paraocular area almost hidden by setae about 0.45 mm long, closely punctured; (31) rest of face visible through setae 0.5 mm long, punctures contiguous to ocellar area; (32) clypeoantennal distance less than interantennal distance and greater than antennocular distance; (33) ocellar area contiguously

punctured; (34) ocelloccipital distance less than ocellular distance and subequal to or greater than interocellar distance; (35) vertex coarsely but contiguously punctured; (36) gena slightly narrower than eye (Fig. 4); (37) hypostomal area bare, separated from gena by carina (Fig. 4); (38) mandible as in female (15 above); (39) scutum as in female (16 above); (40) mesepisternum contiguously punctured; (41) scutellum as in female (18 above); (43) axilla slightly more produced than shown in Figure 23A; (43) metanotum as in female (20 above); (44) front coxal spine robust, about twice as long as broad; (45) terga 1-6 fasciate lateroapically; graduli incomplete medially, mostly bare; tergum 2 with conspicuous foveae (Fig. 25B); tergum 6 with conspicuous dorsal, ventral, and lateral spines (Fig. 25A); tergum 7 rounded apically (Fig. 19A); (46) sterna 1-4 fasciate apically, evenly punctured; (47) sternum 4 submarginally carinate, weakly bidentate apically (Fig. 19B); sternum 5 incurved apically (Fig. 19B); sternum 6 with abundant, long setae (Fig. 19C), sternum 7 represented by 2 small sclerites (Fig. 19D); sternum 8 broadly rounded apically (Fig. 19E); (47) genital armature with long, copious setae on gonocoxites (Fig. 19F).

HOST RECORDS. *Coelioxys funeraria* has been reported from more hosts than any other North American *Coelioxys*. Graenicher (1927) reported *C. funeraria* to be a parasite of *Megachile latimanus*. Medler (1958) reported *C. funeraria* from the nest of *M. inermis*, and Medler and Koerber (1958) reported *C. funeraria* from the nest of *M. relativa*. Mitchell (1962) listed *M. frigida* as a host of *C. funeraria*, and Hobbs (1968) found a fifth host species, *M. rotundata*.

DISTRIBUTION AND SEASON OF FLIGHT. The distribution of *Coelioxys funeraria* extends from above the arctic circle to southern New Mexico (Fig. 20).

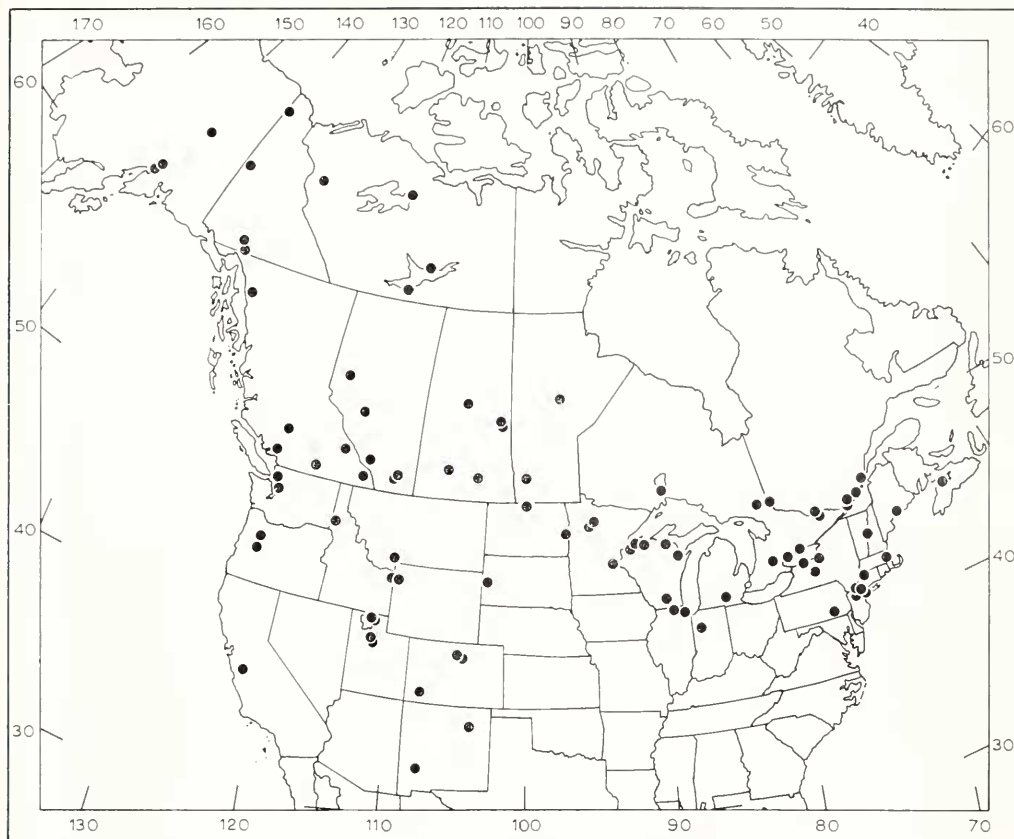
Such a broad distribution, however, is no more remarkable than the distribution of one of the host bees, *Megachile frigida*, which ranges from Alaska to Arizona.

Season of flight lasts at least from May 26 (Ottawa, Ontario) to September 18 (Banff, Alberta) with most specimens taken from mid-June through August.

HABITAT. In the northern portion of its range, *Coelioxys funeraria* is associated with areas designated as various coniferous forests, tundra-coniferous forest, northeastern oak-pine forests, northern floodplain forests, Appalachian oak forest, northern grassland, oak savana, and fescue-wheatgrass vegetation types. Further south *C. funeraria* is associated only with vegetation types which occur at higher elevations such as alpine meadow barrens in Colorado and southwestern spruce-fir forest in New Mexico. In California (Gilroy), *C. funeraria* was taken near an area classified as the ecotone between California oakwoods and fescue-oatgrass vegetation types.

GEOGRAPHIC VARIATION. Although there is considerable variation in size in *Coelioxys funeraria*, larger and smaller specimens occur throughout the range. One explanation for such variation may be that its size is an expression of host size. The large bees may utilize the nests of *Megachile inermis* (15-22 mm). Medium sized *C. funeraria* may utilize the nests of *M. frigida* (12-15 mm) and *M. latimanus* (13-14 mm), and the small *C. funeraria* may utilize the nests of *M. relativa* (9-12 mm) and *M. rotundata* (8-9 mm). The distributions of the host bees overlap over thousands of square miles, and perhaps this overlap accounts for the considerable variation within and between populations of *C. funeraria* from any one area.

COMPARATIVE COMMENTS. *Coelioxys funeraria* is most easily confused with the usually smaller *C. moesta*, but it

FIGURE 20. Distribution of *Coelioxys funeraria*.

is distinguished from *C. moesta* males by the foveae of the second metasomal tergum which are large and almost open along the anterior margin in *C. funeraria* (Fig. 25B) and small and enclosed in *C. moesta* (Fig. 25E). The female of *C. funeraria* possesses a convex clypeus with a slightly outcurved margin (Fig. 22A) whereas the female of *C. moesta* possesses a flat clypeus with a triangularly produced margin (as in Fig. 22D).

Subgenus *Boreocoelioxys* Mitchell

Boreocoelioxys Mitchell, 1973. A subgeneric revision of the genus *Coelioxys* of the Western Hemisphere. Cont. Dept. Entomol. North Carolina State Univ. p. 37. Type species: *Coelioxys rufitarsis* Smith.

Other bees in the subgenus *Boreocoelioxys* are *C. banksi*, *C. insita*, *C. moesta*, *C. novomexicana*, *C. oaxacana*, *C. octodentata*, *C. porterae*, *C. pratti*, and *C. sayi*. These bees are usually black or dark brown except for the legs which may vary from black to bright ferruginous.

Host-parasite relationships are not clear-cut for *Boreocoelioxys*. The large number of hosts utilized probably reflects a generalized response of female *Coelioxys* to nests of *Megachile* occurring within the habitat. Species from the group have been reared from the following subgenera of *Megachile*: *Delomegachile*, *Eutricharaea*, *Litomegachile*, *Megachile*, *Pseudocentron*, and *Xanthosarus* (Table 1).

Most of the characters in the list below are found in other subgenera of New World *Coelioxys* and even in some of the Old World *Liothyrapis*, but never in this combination. This group is the only North American group with complete graduli on meta-

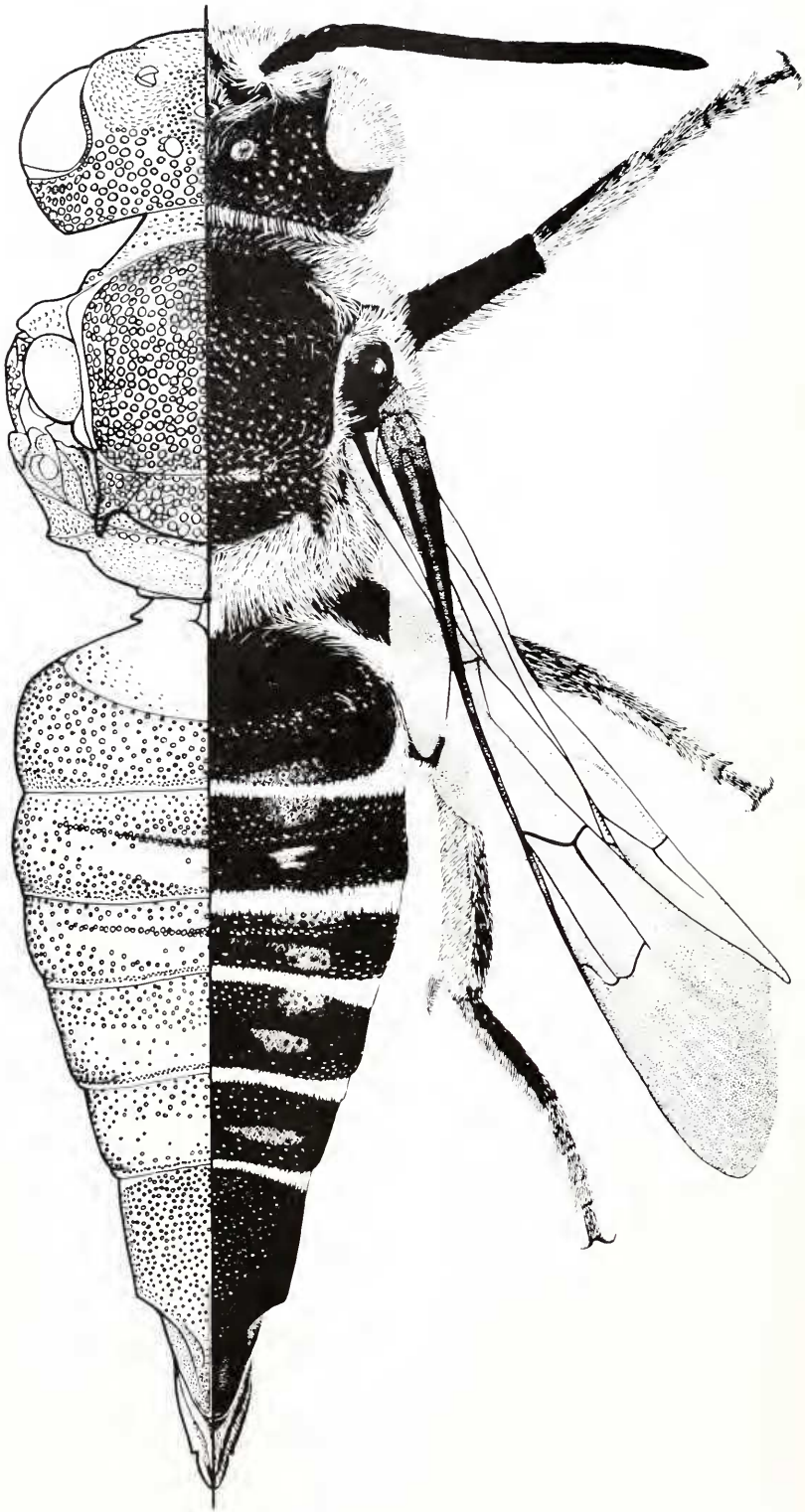


FIGURE 21. Dorsal view of female *Coelioxys rufitarsis*, left half showing punctation, right half with melanization and pubescence added.

somal terga two and three and notched sixth metasomal sterna in females or foveae on metasomal tergum two in males. Italicized characters most clearly differentiate *Boreocoelioxys* from other subgenera in North America.

A. Ocellar area closely punctured (Fig. 21).

B. Preoccipital carina incomplete medially.

C. Mandible with outer surface broadly rounded to humped (Fig. 22B-G).

D. Prothoracic tubercle with carina usually produced into thin, plate-like structure.

E. Scutum closely punctured, sometimes with conspicuous fasciae (Fig. 21).

F. Scutellum contiguously to moderately punctured (Fig. 23B-D).

G. Axillae well produced (Fig. 21, 23B-D).

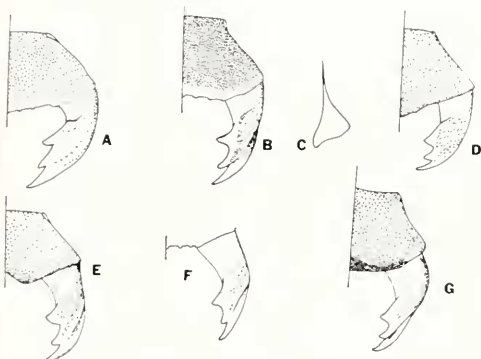


FIGURE 22. Left half of clypeus and mandible of females of *Coelioxys*. A. *C. funearia*; B. *C. rufitarsis*; C. Lateral view of clypeus of *C. banksi*; D. *C. banksi*; E. *C. novomexicana*; F. *C. porterae*; G. *C. sayi*.

H. Mesepisternum with lateral surface closely punctured.

I. *Graduli* complete on metasomal terga two and three (Figs. 21, 25B).

J. Female: fore coxal spine small, inconspicuous.

K. Female: sixth metasomal sternum elongate and notched (Figs. 21, 24B-L).

L. Male: hypostomal area of gena with excavation bare, shining.

M. Male: conspicuous foveae on metasomal tergum two (Fig. 25B).

N. Male: fifth metasomal tergum with lateral spine (Fig. 25B).

O. Male: sixth metasomal tergum with conspicuous spines (Fig. 25B).

P. Male: apex of metasomal tergum seven rounded (Fig. 26A).

Q. Male: apex of metasomal sternum four conspicuously emarginate (Fig. 26B).

R. Male: sternum seven represented by two small sclerites (Fig. 26D).



FIGURE 23. Scutellum and axillae of females of *Coelioxys*. A. *C. funearia*; B. *C. moesta*; C. *C. oaxacana*.

KEY TO FEMALES OF *Boreocoelioxys*

1. Clypeal margin with distinct emargination evident in frontal view with full complement of setae 4
Clypeal margin otherwise 2
2. Clypeal margin outcurved 3
Clypeal margin straight 5
3. Clypeus concave in profile *banksi*
Clypeus straight in profile *moesta*
4. Clypeal margin with dense fringe of white setae almost perpendicular to surface *sayi*
Clypeal margin with dense fringe of yellowish setae almost parallel to surface *novomexicana*

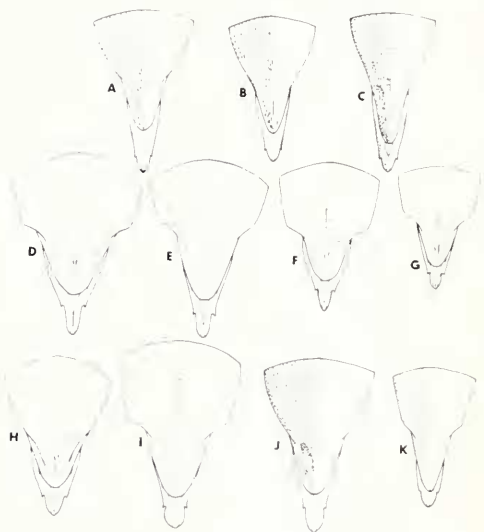


FIGURE 24. Sixth metasomal tergum and sternum of females of *Coelioxys*. A. *C. funearia*; B. *C. banksi*; C. *C. moesta*; D-I. *C. octodentata* showing variation in lateral angles of tergum, apex of sternum; J. *C. porterae*; K. *C. oaxacana*.

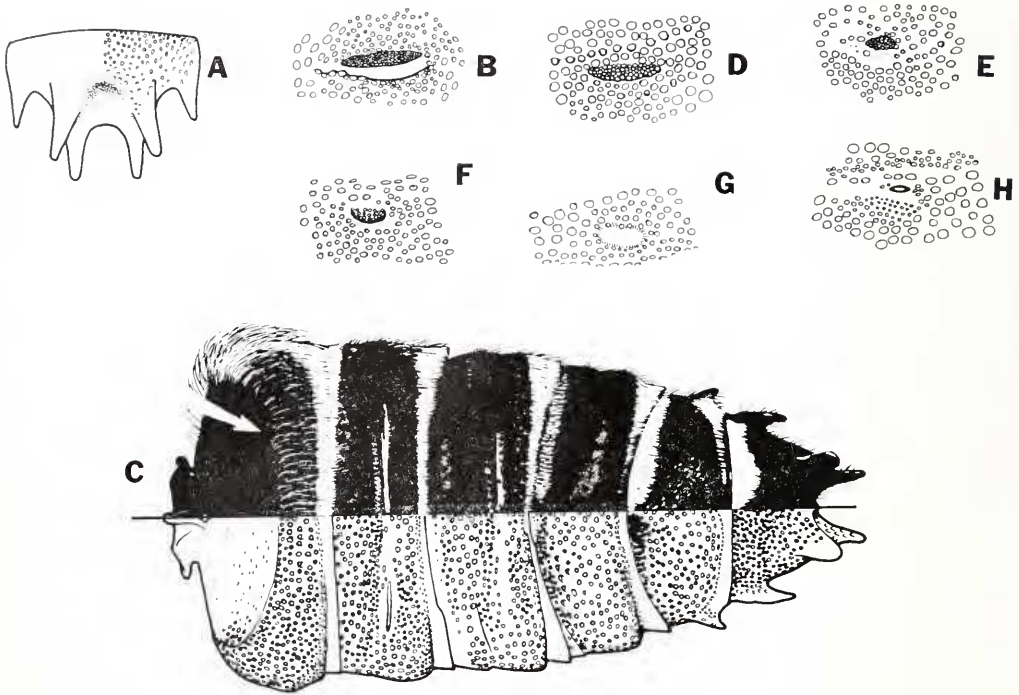


FIGURE 25. Various parts of males of *Coelioxys*. A-B, *C. juneraria*. A, Sixth metasomal tergum; B, Fovea. C, Metasoma, *C. rufitarsis* (arrow indicates median fascia). D-H, Foveal areas. D, *C. banksi*; E, *C. moesta*; F, *C. porterae*; G, *C. octodentata*; H, *C. grindeliae*.

5. Scutellum with median longitudinal ridge *oaxacana*
Scutellum without median longitudinal ridge 6
6. Tergum six in dorsal view angulate as in Figure 21 7
Tergum six in dorsal view less angulate than shown in Figure 24 J 8
7. Ocular hairs long (about 0.15 mm); tergum six with tiny setae ventral to angles which have a velvety appearance; tergum one with median fascia (see arrow on Fig. 25C) of long, slender, erect setae *rufitarsis*
Ocular hairs short (about 0.05 mm); tergum six with squamose white setae ventral to angles; tergum one with median fascia of prostrate setae, if slender than short *octodentata**
8. Conspicuous fasciae laterally and anteriorly around scutum; ocular hairs long (about 0.15 mm) *pratti*
Scutum with no conspicuous fasciae; ocular hairs variable 9
9. Sterna one to five ferruginous apically. *octodentata**

- Sterna one to five very dark to black apically 10
10. Legs black or very dark brown .. *porterae*
Legs brownish to ferruginous 11
11. Tergum six broadly rounded apically (Fig. 24E-J) *octodentata**
Tergum six narrow apically (as in Fig. 24B) *insita*

* Occurs more than once in key.

KEY TO MALES OF *Boreocoelioxys*

1. Fovea on metasomal tergum two wide, deep, short, conspicuous; margins of fovea impunctate (Fig. 25C); bee robust *rufitarsis*
Fovea on metasomal tergum two variable, if wide, then anterior margin punctate; bee variable in form 2
2. Fovea on metasomal tergum two shallow (as in Fig. 25D) or with anterior margin lower than posterior margin (as in Fig. 25F) and sometimes closely punctate 3
Fovea on metasomal tergum two deep (as in Fig. 25G) with margins the

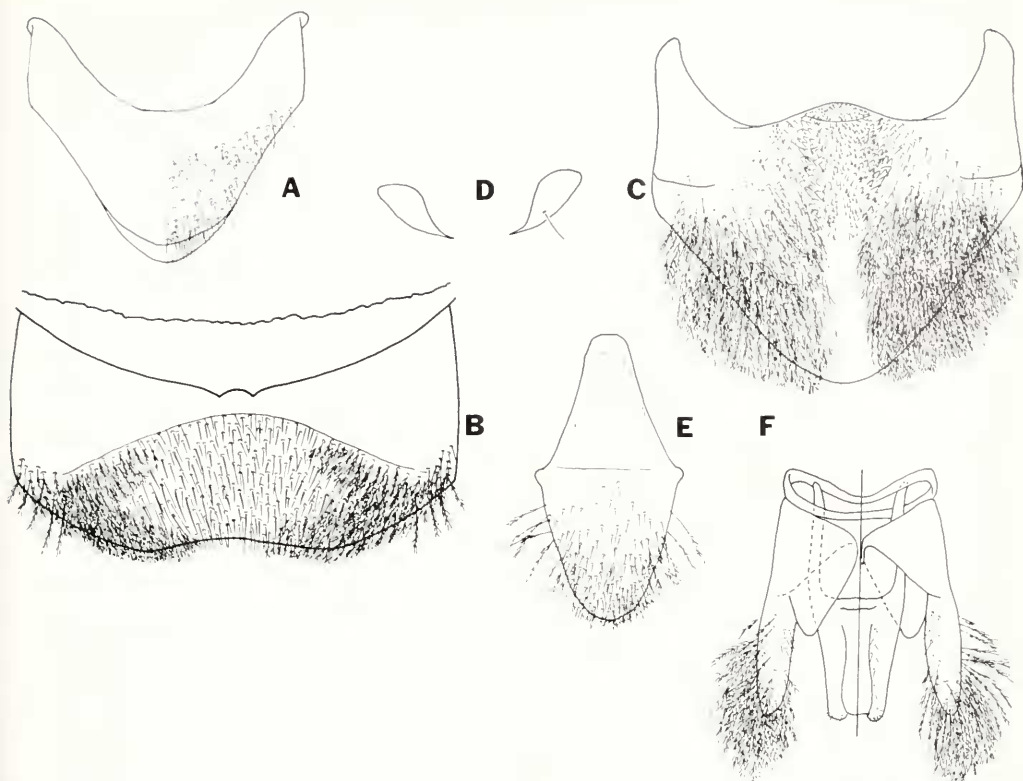


FIGURE 26. Hidden sclerites of male of *Coelioxys rufitarsis*. A, Seventh tergum; B, Margin of fourth sternum, fifth sternum; C, Sixth sternum; D, Seventh sternum (represented by two sclerites); E, Eighth sternum F, Genital armature.

- same height, anterior margin may be moderately punctate 4
3. Scutellum with dorsal and posterior surfaces separated medially by a carina, punctures deep and contiguous; legs usually with ferruginous areas; fovea on metasomal tergum two complete or with anterior margin weak (as in Fig. 25D) *banksi, insita*
Scutellum convex, punctures contiguous but so broad that edges become minute carinae above the flat surfaces of the puncture floors; legs usually black or blackish-brown; fovea on metasomal tergum two with anterior margin weaker than posterior margin (Fig. 25F) *porterae*
4. Fovea on metasomal tergum two inconspicuous, sometimes shallow (Fig. 25E); integument usually black; medium to small, slender bee *moesta*
Fovea on metasomal two deep and conspicuous (as in Fig. 25G) with small, contiguous punctures immediately posterior to it; integument variable in color; medium to large bee 5
5. Posterior margins of gradular grooves on metasomal terga two and three almost obliterated medially *sayi*
Posterior margins of gradular grooves on metasomal terga two and three distinct medially 6
6. Ocular hairs long (about 0.15 mm); punctuation of vertex with conspicuous interspaces; scutum with conspicuous anterolateral fasciae; posterior surface of scutellum with conspicuous fascia *pratti*
Ocular hairs short (about 0.06 mm); punctuation of vertex variable; scutum laterally and scutellum posteriorly without conspicuous fasciae.
..... *novomexicana, octodentata*
- Coelioxys rufitarsis* Smith
Figures 21, 22B, 25C, 26A-F, 27, 28
Coelioxys rufitarsis Smith, 1854, Catalogue

of Hymenoptera in the British Museum 2:271 (δ , United States, type in the British Museum); Graenicher, 1905, Bull. Wisconsin Natur. Hist. Soc. 3: 162-163 (Host); Graenicher, 1906, Bull. Wisconsin Natur. Hist. Soc. 4:138 (Biology); Robertson, 1926, Psyche 33: 116 (Host); Hicks, 1926, Univ. Colorado Stud. 15:230 (Host); Graenicher, 1927, Entomol. News 38:233 (Biology); Robertson, 1929, Flowers and Insects, Lancaster Pennsylvania Sci. Press: 9-142 (Flower Records); Medler and Lussenhop, 1968, Univ. Wisconsin Research Bull. 274:57 (Key, diagnosis, biology).

Coelioxys dubitata Smith, 1854, Cat. Hymenoptera Brit. Mus. 2:272 (η , Florida, type in the British Museum); Robertson, 1897, Trans. Acad. Sci. St. Louis 7:345 (= *rufitarsis*); Graenicher, 1935, Ann. Entomol. Soc. Amer. 28: 300, 304 (Distribution, host).

Coelioxys comstockii Cresson, 1878, Trans. Amer. Entomol. Soc. 7:96 (η , New York, type # 2497 in the Academy of Natural Sciences of Philadelphia) NEW SYNONYMY.

Coelioxys coloradensis Cresson, 1878, Trans. Amer. Entomol. Soc. 7:98 (δ , Colorado, type # 2500 in the Academy of Natural Sciences of Philadelphia) NEW SYNONYMY; Hicks, 1926, Univ. Colorado Stud. 15:233 (Host); Graenicher, 1935, Ann. Entomol. Soc. Amer. 28:300 (Host).

Coelioxys rufitarsis rhois Cockerell, 1903, Ann. Mag. Natur. Hist. 12:452 (η , New Mexico, type in the American Museum of Natural History).

Coelioxys rufitarsis claripes Cockerell, 1925, Pan-Pacific Entomol. 1:146, 150 (δ , California, type # 1633 in the California Academy of Sciences).

Coelioxys rufitarsis rufitarsis; Mitchell, 1962, North Carolina Agr. Exp. Sta.

Tech. Bull. 152:193-194, 220 (Key, re-description).

FEMALE. (1) Length 11-13 mm; (2) integument granular on vertex between punctures and on thorax; black, dark brown on ventral surface of tergum 1, legs distal to coxae black to ferruginous; (3) pubescence white, golden on tarsi; (4) ocular hairs long (about 0.15 mm); (5) clypeus uniformly covered with short, appressed setae, surface visible, margin irregular (Fig. 22B); (6) clypeoantennal distance shorter than lateral margin of clypeus; (7) paraocular area hidden by setae about 0.25 mm long; (8) rest of face rugose, closely punctured up to ocellar area except for small median impunctate ridge between antennae; (9) clypeoantennal distance less than interantennal and greater than antennocular distances; (10) ocellar area closely punctate; (11) inter-ocellar distance greater than ocellocipital and less than ocellocular distances; (12) vertex moderately punctate (Fig. 21); (13) gena narrower than eye, integument visible, ventral angle about 90° ; (14) hypostomal area of gena with setae longer than on disc; (15) mandibles short, broad (Fig. 22B); (16) scutum with slender, erect hair on disc (Fig. 21); (17) lateral surface of mesepisternum closely punctate with long (about 0.35 mm), slender setae which usually form anterior and posterior fasciae; (18) scutellum with posterior margin of dorsal surface rounded (Fig. 21); (19) axilla well produced (Fig. 21); (20) metanotal setae erect except for 1-3 or 4 prostrate in center; (21) front coxal spine subtriangular, inconspicuous; (22) terga 2, 3 with conspicuous gradular grooves, terga 1-5 with conspicuous apical fasciae, tergum 6 angled with very small setae at angles which resemble velvet in dorsal view (Fig. 21); (23) sterna 1-5 fasciate apically, fasciae of sterna 2-4 usually interrupted medially, sterna 1-4 and basal area of sternum 5 deeply and evenly

punctured, sternum 5 apically very closely and shallowly punctured, sternum 6 with indistinct elongate punctures medially, broadly lanceolate apically (Fig. 21).

MALE. (24) Length 9.5-12 mm; (25) integument as in female (2 above), venter of abdomen black to dark brown; (26) pubescence white, white to yellow on face, white to pale brown on thorax, golden on tarsi; (27) ocular hairs long (about 0.15 mm); (28) clypeus hidden by copious long (about 0.45 mm) setae, surface rugose and shiny; clypeal margin slightly emarginated with 5 small denticles; (29) clypeo-antennal distance as in female (6 above); (30) paraocular area hidden by long setae (about 0.6 mm); (31) rest of face rugose with median, short (0.25 mm), impunctate line usually obscured by copious setae up to 0.45 mm long; (32) interantennal, clypeoantennal, antennocular distances as in female (9 above); (33) ocellar area as in female (10 above); (34) interocellar and ocellocipital distances equal, less than ocellocular distance; (35) vertex as in female (12 above); (36) gena as in female (13 above) but ventral angle greater than 90°; (37) hypostomal area of gena modified into distinct excavation (as in Fig. 4), anterior portion with setae as in female (14 above), posterior portion with integument clearly visible; (38) mandible, scutum, mesepisternum, scutellum, axilla, metanotal setae as in female (15-20 above); (44) front coxal spine long (about 0.25 mm) and broad (about 0.2 mm) with setae on dorsal and ventral surfaces, rounded apically, directed anteriorly; (45) terga with apical fasciae diminishing posteriorly, gradular grooves of terga 4-6 with fasciae, fovea on tergum 2 less than 0.05 mm long and 0.3-0.5 mm wide (Fig. 25C), tergum 6 with dorsal spines stouter than ventral spines (Fig. 25C); tergum 7 unmodified (Fig. 26A); (46) sterna 1-4 evenly punctate with small slender seta in each puncture, fasciate apically, sternum

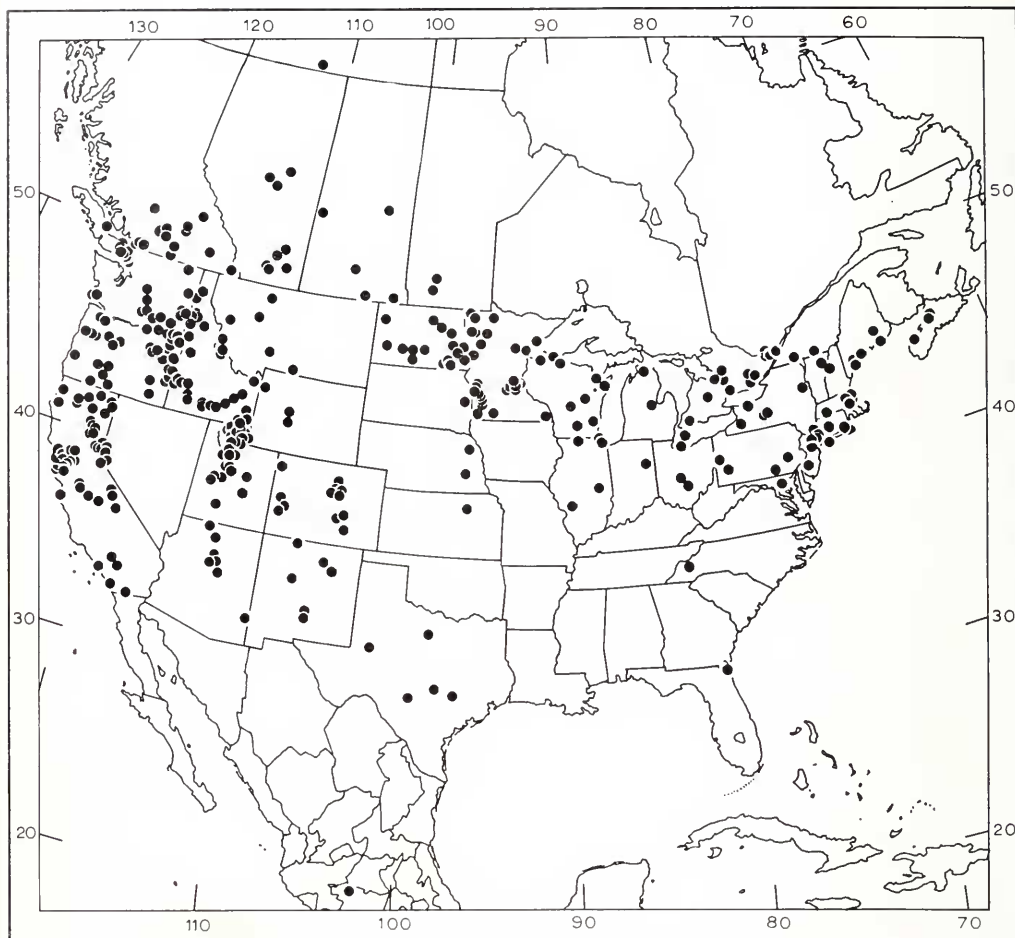
1 fasciate medially; (47) sternum 4 submarginally carinate, apex emarginate to bidentate, margin of sternum 5 slightly emarginate (Fig. 26B), sternum 6 with copious setae lateroapically (Fig. 26C), sternum 7 with two sclerotized areas (Fig. 26D), sternum 8 with base broad (Fig. 26E), genital armature with abundant setae on gonocoxite apically (Fig. 26F).

HOST RECORDS. Graenicher (1905) reared *Coelioxys rufitarsis* from nests of *Megachile latimanus* and *M. melanophaea*. He later (1935) reported *C. rufitarsis* to be a parasite of *M. melanophaea wootoni*. Hicks (1926) reared *C. rufitarsis* (= *C. coloradensis*) from a nest of *M. montivaga*. Medler and Lussenhop (1968) reported that D. H. Pengelly found *C. rufitarsis* to be a parasite of *M. texana*. Mitchell (1973) indicated *M. fortis* is another host of *C. rufitarsis*. A new host record from a label of *C. rufitarsis* from Alberta, Canada, is *M. perihirta*.

DISTRIBUTION AND SEASON OF FLIGHT. This bee extends from middle Canada well into Mexico (Fig. 27). Although Smith (1854) described the female of *Coelioxys rufitarsis* from Florida, specimens from south of the 35° parallel are rare.

Coelioxys rufitarsis is in flight at least from April 22 (Texas) and May 21 (Idaho) to October 3 (central California).

HABITAT. *Coelioxys rufitarsis* ranges through areas which have been classified as a variety of forest, savana, and open grassland vegetation types. In the West this bee has been taken from areas classified as forests containing such dominant trees as spruce (*Picea*), cedars (*Thuja Libocedrus*), hemlock (*Tsuga*), fir (*Abies*), and pine (*Pinus*); from areas classified as scrub and savana such as chaparral, mountain mahogany-oak scrub and oak savana (*Cercocarpus*, *Quercus*, *Andropogon*), juniper-oak savana (*Juniperus*, *Quercus*, *Andropogon*), sagebrush (*Salvia*, *Eriogo-*

FIGURE 27. Distribution of *Coelioxys rufitarsis*.

num, *Artemisia*), and creosote bush (*Larrea*); from areas classified as various grasslands containing grasses such as fescue (*Festuca*), oatgrass (*Danthonia*), tule (*Scirpus*), cattail (*Typha*), grama grass (*Bouteloua*), and bluestem (*Andropogon*); and from an area classified as alpine meadows and barren.

In the East *Coelioxys rufitarsis* has been taken from areas classified as a variety of northern coniferous, hardwood and mixed forests. In Florida it has been collected in southern mixed forest.

GEOGRAPHIC VARIATION. As with *Coelioxys alternata*, leg color of *C. rufitarsis* varies throughout its distribution

and seemingly without respect to geography. However, an exceptionally large series of *C. rufitarsis* from California showed possible geographic variation (Fig. 28). The proportion of bees with dark legs was greater for bees from higher elevations than for bees from the San Joaquin and Sacramento Valleys. However, bees with both dark and ferruginous legs occurred at high and low elevations.

Color of the pubescence of males seemed to vary geographically. Some males from the western portion of the distribution of *Coelioxys rufitarsis* possess yellowish facial pubescence and slightly brownish thoracic pubescence. This con-

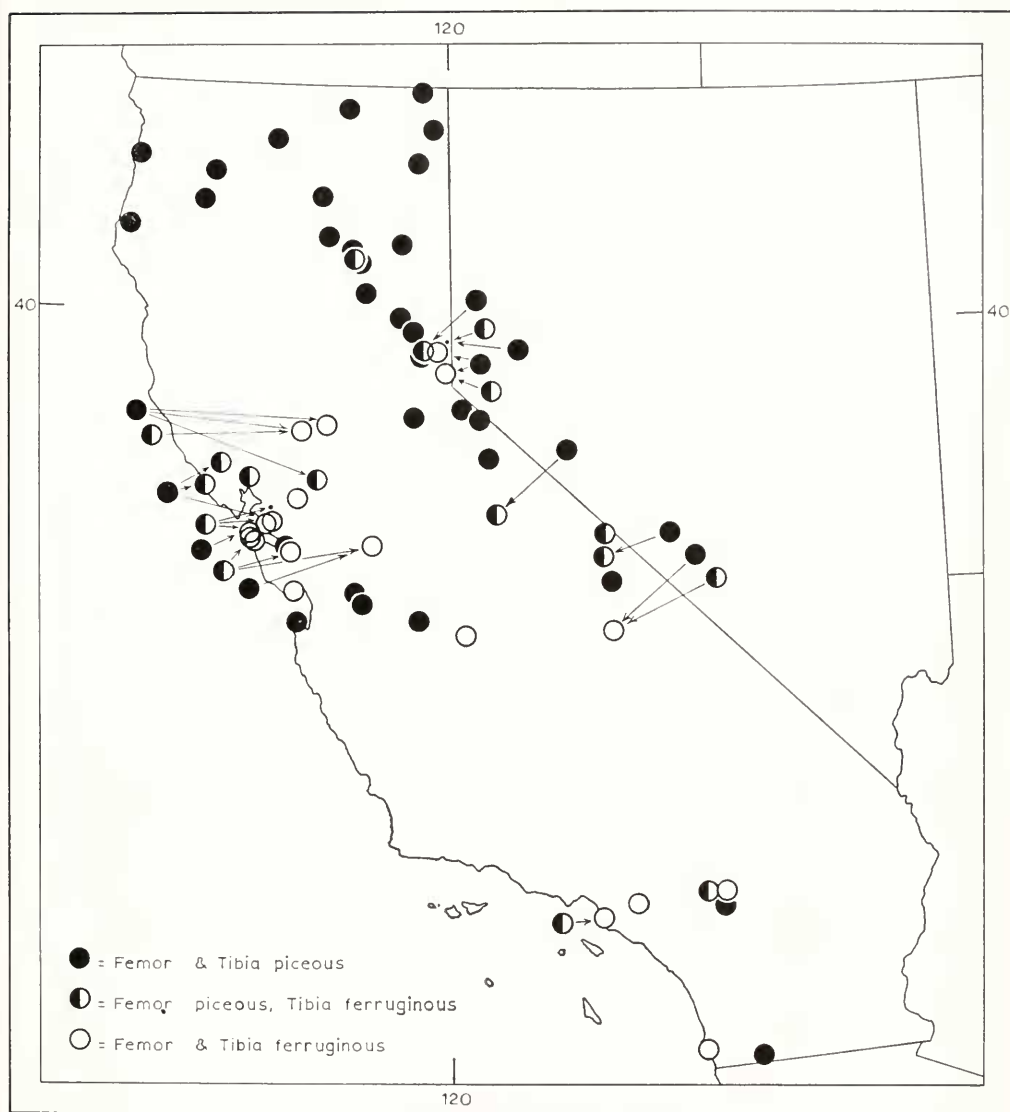


FIGURE 28. Distribution of *Coelioxys rufitarsis* in California showing variation in leg color.

dition was especially evident in bees from Zacapu, Michoacan, Mexico. However, bees in this condition were also taken in southwestern Canada and Ithaca, New York. Perhaps the yellow or brown condition of the pubescence is due to the teneral conditions of these specimens. Teneral adults of *Megachile brevis* and *M. mendica* possess bright yellow (almost orange-yellow in *M. mendica*) pubescence

whereas that of specimens from the field is white.

The name *Coelioxys comstockii* is represented only by the type specimen in the Academy of Natural Sciences of Philadelphia and seems to be a teratological specimen. The metasoma appears to be discolored; the metasoma is asymmetrically punctured (some punctures appear to be missing on one side); and the apex

of tergum six appears to be broken. Pollen on the sixth metasomal sternum indicates the bee may have been worn before collection. In other respects, however, the specimen agrees with the description above.

COMPARATIVE COMMENTS.

Coelioxys rufitarsis is most easily confused with the larger western specimens of *C. octodentata* but differs in the females by the basal fascia on metasomal tergum one which is composed of long, slender, erect setae in *C. rufitarsis* (Fig. 21) and at least partially composed of squamose setae in *C. octodentata*. Males of *C. rufitarsis* possess foveae (Fig. 25C) which are wider, deeper, and shorter than those of *C. banksi* and *C. insita* (Fig. 25D) and are unlike the more oval foveae of all other North American *Coelioxys* which possess foveae on the second tergum of the metasoma.

Coelioxys banksi Crawford
Figures 22C-D, 24B, 25D, 29

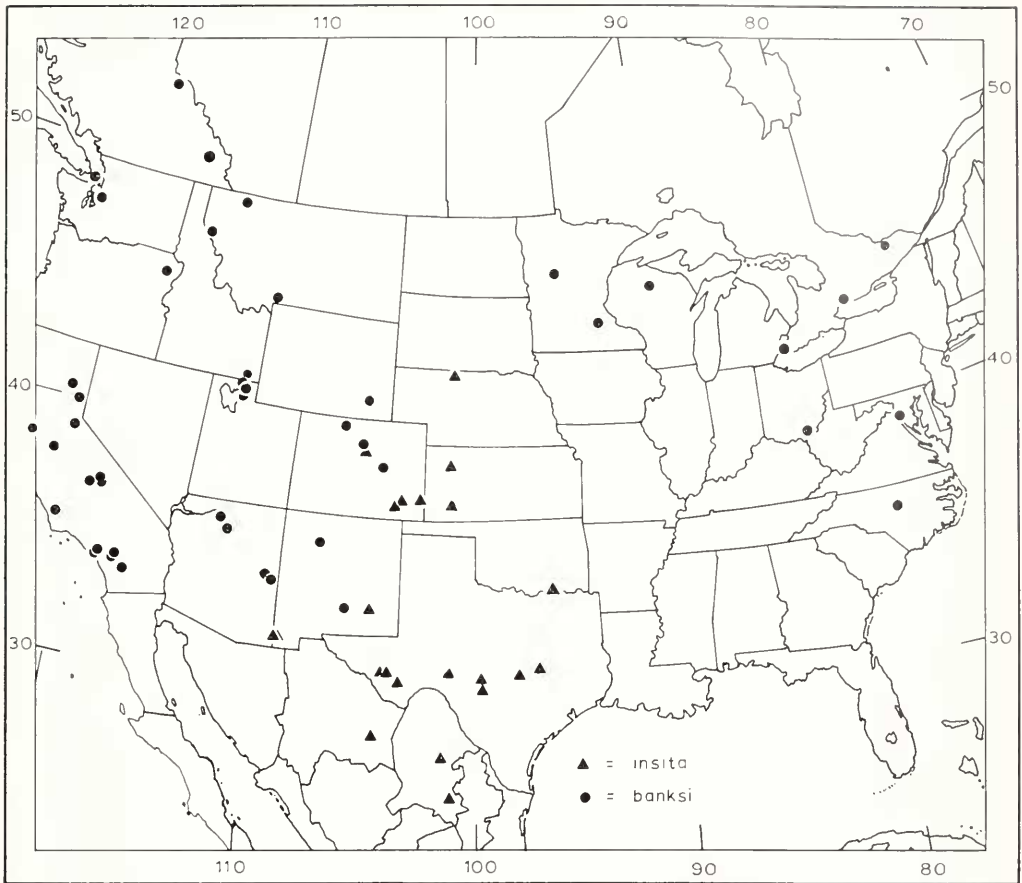
Coelioxys banksi Crawford, 1914, Ann. Entomol. Soc. Amer. 7:155 (♀, Virginia, type # 18221 in the National Museum of Natural History); Medler and Koerber, 1958, Ann. Entomol. Soc. Amer. 51:343 (Biology); Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:213 (= *C. moesta*, misidentification).

Coelioxys angulifera Cockerell, 1916, Pomona J. Entomol. Zool. 8:61 (♀, ♂, California, type in the American Museum of Natural History) NEW SYNONYMY.

FEMALE: Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (1) Length 10-13 mm; (2) integument black, becoming brown to ferruginous on tegula, legs distal to base of femora, and metasomal venter; (4) ocular hairs short (about 0.05 mm); (5) clypeal margin outcurved and produced anteriorly,

clypeal profile concave (Fig. 22C-D); (7) paraocular area almost hidden by appressed setae about 0.15 mm long; (10) ocellar area in some specimens with irregular, impunctate areas, usually narrower than puncture width anterior to median ocellus; (11) interocellar distance equal to ocellocipital distance, less than ocellocular distance; (13) gena equal in width to light portion of eye; (14) hypostomal area of gena with setae as long as or slightly longer than setae on lower disc; (16) scutum with slender, erect setae and with anterolateral fascia sometimes less conspicuous than shown in Figure 21; (17) mesepisternum in some specimens with an occasional minute puncture among large punctures, usually closely punctured; (22) terga 2-5 slightly more closely punctured on postgradular area than shown in Fig. 21, gradular groove of tergum 3 less conspicuous than shown in Fig. 21, tergum 6 not angled laterally but produced posteriorly (Fig. 24B); (23) sternum 6 elongate, apex lanceolate (Fig. 24B).

MALE: Agrees with figures and description of *C. rufitarsis* except as follows: (24) Length 9.5-11.5 mm; (25) integument faintly rugulose on metasoma between punctures; tegula black to brown; (26) pubescence as in female (3 above); (27) ocular hairs of medium length (about 0.09 mm); (31) rest of face coarsely, contiguously punctured, with long (0.3 mm), slender setae; (33) ocellar area contiguously punctured; (34) ocellocipital distance greater than interocellar distance, less than ocellocular distance; (37) hypostomal area of gena with pubescence on anterior portion shorter than on gena; (39) scutum as in female (16 above); (43) metanotum with erect, slender setae; (45) fovea on tergum 2 about 0.06 mm long and 0.3 mm wide (Fig. 25D); tergum 6 with depression between dorsal spines slightly deeper and wider than shown in Figure 25C.

FIGURE 29. Distributions of *Coelioxys banksi* and *C. insita*.

HOST RECORDS. Medler and Koerber (1958) reported rearing *Coelioxys banksi* from nests of *Megachile relativa*.

DISTRIBUTION AND SEASON OF FLIGHT. This species has been collected throughout the western half and north-eastern quarter of the United States (Figure 29). It appears to be rare throughout its range.

Coelioxys banksi is in flight from at least April 16 (central California) to September 20 (Toronto, Ontario).

HABITAT. *Coelioxys banksi* has been taken mainly from areas classified as western coniferous and northern hardwood forests. The western forests are dominated by such trees as cedar (*Thuja*), hemlock (*Tsuga*), and Douglas fir (*Pseu-*

dotsuga), grand fir (*Abies*), pine (*Pinus*), and spruce (*Picea*). Two areas, one in California, classified as coastal sagebrush (*Salvia*, *Eriogonum*) and the other in Utah classified as mountain mahogany-oak shrub (*Cercocarpus*, *Quercus*), were the only western areas not dominated by conifers. In the East this bee was taken from an area classified as mixed mesophytic forest (*Acer*, *Aesculus*, *Fagus*, *Liriodendron*, *Quercus*, *Tilia*) and an area classified as northern hardwoods forest (*Acer*, *Betula*, *Fagus*, *Tsuga*). Perhaps *C. banksi* is excluded from the western, central, and eastern grasslands by *C. insita*.

GEOGRAPHIC VARIATION. The variation described above does not seem to be related to geography. *Coelioxys banksi*

shows a problem that is recurrent in New World *Coelioxys*; this species and *C. insita* (treated next) differ largely in the configuration of the anterior margin of the clypeus of the female (males are indistinguishable). In *C. banksi* the clypeal margin is produced medially (Fig. 22C-D) whereas the clypeal margin is almost straight to slightly outcurved in *C. insita*. There seem to be no intermediates (15 specimens of *C. banksi* and 20 specimens of *C. insita*). Whether these alternate conditions are the result of polymorphism within one species or indicate the presence of two species cannot be determined from dead specimens. Unless it is demonstrated that there is only one species, it seems best to recognize two.

Similar pairs of species separated by the anterior margin of the clypeus of the female (males indistinguishable) are found again in this group (*Coelioxys octodentata* and *C. novomexicana*, further discussion below) and in a Neotropical group (*C. zapoteca* and *C. clypeata*).

COMPARATIVE COMMENTS. Females of *Coelioxys banksi* differ from all other females in this group by the anterior margin of the clypeus which is produced and raised medially, making the profile distinctly concave (Fig. 22C-D). Males of *C. banksi* differ from other males in this group (except those of *C. insita* which are distinguishable by distribution only) by the almost linear shape of the fovea on the second metasomal tergum (Fig. 25D). The anterior margin of the fovea is usually very closely punctured.

Coelioxys insita Cresson
Figure 29

- Coelioxys insita* Cresson, 1872, Trans. Amer. Entomol. Soc. 4:273 (♀, Texas, type # 2499 in the Academy of Natural Sciences of Philadelphia).
Coelioxys rudis Cockerell, 1934, Amer. Mus. Novitates 732:3-4 (♀, Colorado,

type in the American Museum of Natural History) **NEW SYNONYMY.**

FEMALE. Agrees with description and figures of *Coelioxys banksi* except as follows: (5) clypeal margin almost straight to slightly undulating or slightly outcurved; clypeal profile straight.

MALE. Agrees with description and figures of *Coelioxys banksi*.

DISTRIBUTION AND SEASON OF FLIGHT. This bee ranges from Nebraska to northern Mexico and to Arizona (Fig. 29).

Coelioxys insita is in flight at least from April 11 (Texas) to September 15 (Arizona) and October 15 (Mexico).

HABITAT. The distribution of *Coelioxys insita* extends westward to an area classified as pine-Douglas fir forest (*Pinus*, *Pseudotsuga*) in Colorado and eastward to an area classified as oak-hickory forest (*Quercus*, *Carya*) in Texas. This bee has also been taken from areas classified as eastern ponderosa pine forest, oak-juniper woodland (*Juniperus*), mesquite-oak savana (*Prosopis*, *Quercus*, *Andropogon*), mesquite-buffalo grass (*Buchloe*), creosote bush-tarbrush (*Larrea*, *Flourensia*), and grama-tobosa-shrubsteppe (*Bouteloua*, *Hilaria*) vegetation types. The remaining areas are classified as western grassland and central and eastern grassland containing such dominant grasses as grama, tobosa, buffalo grass (*Buchloe*), bluestem (*Andropogon*), switchgrass (*Panicum*), and Indian grass (*Sorghastrum*).

Coelioxys moesta Cresson
Figures 23B, 24C, 25E, 30

- Coelioxys moesta* Cresson, 1864, Proc. Entomol. Soc. Philadelphia 2:403 (♀, Connecticut, type # 2491 in the Academy of Natural Sciences of Philadelphia); Graenicher, 1927, Entomol. News 38:233, 274 (Biology); Medler and Koerber, 1958, Ann. Entomol. Soc. Amer. 51:337, 343 (Biology); Medler,

1959, Can. Entomol. 91:114-115 (Biology); Bohart, 1970, Utah State Univ. 41st Faculty Honor Lecture, p. 9 (Immature).

Coelioxys tristis Provancher, 1882, Natur. Can. 13:241 (Lapsus for *C. moesta*).

Coelioxys lutsi Cockerell, 1921, Amer. Mus. Novitates 21:5-6 (♀, ♂, Utah, Colorado, type in the American Museum of Natural History) NEW SYNONYMY.

FEMALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (1) Length 10-12 mm; (2) integument black, tegula, legs and apex of metasoma black to dark brown; (3) pubescence white, scattered golden erect setae on clypeus, golden setae on tarsi; (4) ocular hairs short (about 0.7 mm); (5) clypeus covered by short appressed setae and erect golden setae which are more numerous near apical margin, margin broadly out-curved, clypeal profile straight; (7) paraocular area almost obscured by setae about 0.2 mm long; (11) interocellar distance slightly greater than ocellocipital distance and less than ocellocular distance; (14) hypostomal area with setae subequal in length to those on disc; (16) scutum with almost no squamose setae; (17) setae of mesepisternum usually not forming discrete fasciae; (19) axilla short (Fig. 23B); (20) metanotal setae erect, (22) terga 2, 3 with less conspicuous gradular grooves than shown in Figure 21, gradular groove of tergum 3 almost obliterated medially, postgradular areas more closely punctured than shown in Figure 21, fasciae of terga 4, 5 almost obliterated medially, tergum 6 not angled, elongate (Fig. 24C); (23) sternum 6 elongate, lanceolate apically (Fig. 24C).

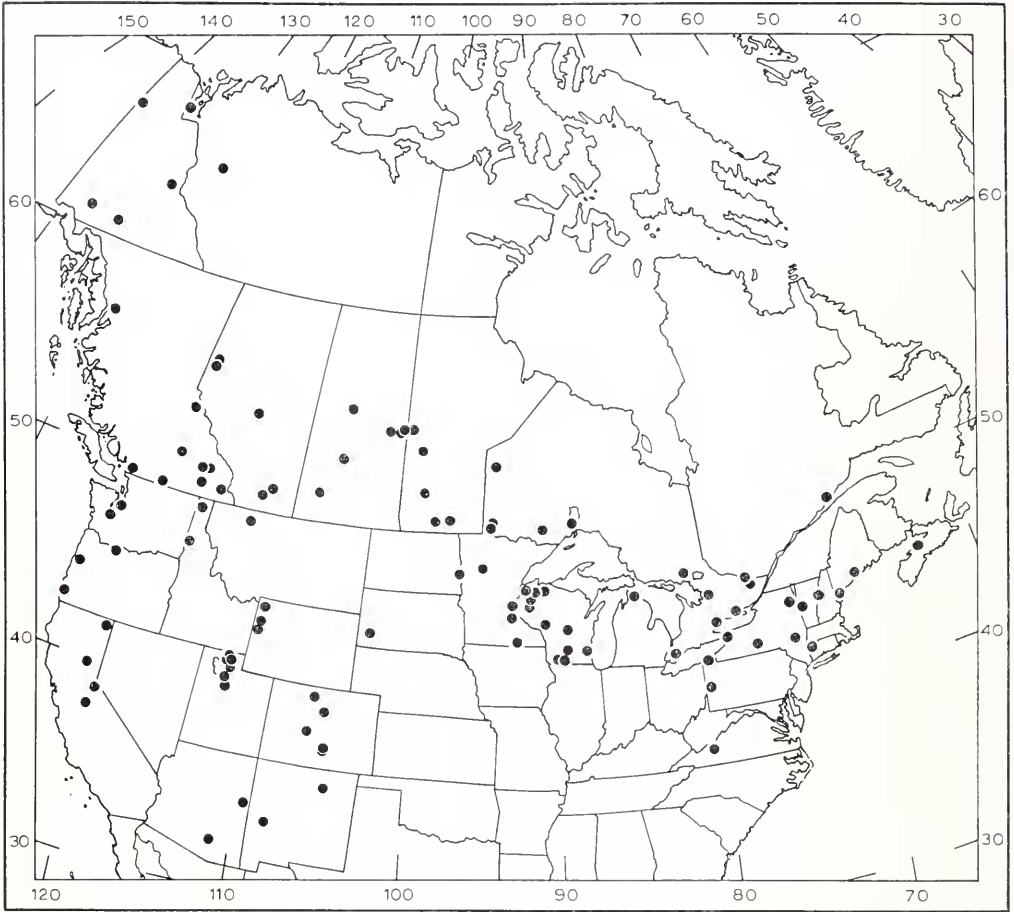
MALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (24) Length 7-11 mm; (25) integument as in female (2 above); (26) pubescence white, golden on tarsi; (27) clypeal

margin irregular with 5 or 6 small denticles; (30) paraocular area with integument rugose, visible among long (0.35 mm), slender, erect setae; (31) rest of face contiguously, deeply punctured to ocellar area, visible among slender setae (about 0.5 mm long); (34) ocellocipital distance subequal to or greater than interocellar distance, less than ocellocular distance; (35) vertex more closely punctured than shown in Figure 21; gena in lateral view subequal in width to eye, ventral angle greater than 90°; (37) hypostomal area of gena with dorsal carina of excavation extending to the preoccipital carina, excavation with setae of anterior fascia denser ventrally and longer than setae on disc; (39) scutum as in female (16 above); (41) fasciae of mesepisternum indistinct; (42) axilla as in female (19 above); (43) metanotum as in female (20 above); (45) terga 1-4 with apical fasciae incomplete medially, apical fascia missing on tergum 5; gradular grooves on terga 4-6 with fasciae weak; gradular groove on tergum 2 almost obliterated medially; fovea on tergum 2 inconspicuous, shallow, about 0.05 mm long, 0.1 mm wide (Fig. 25E); (47) setae on gonocoxites not as copious as shown in Figure 26F.

HOST RECORDS. Medler and Koerber (1958) reported *Coelioxys moesta* to be a parasite of *Megachile relativa*; Medler (1959) recorded *M. centuncularis* as a host; and Medler and Lussenhop (1968) related that D. H. Pengelly reared *C. moesta* from the nests of *M. texana* and *M. frigida*. Hobbs (1968) noted *C. moesta* as a probable parasite of *M. rotundata*. A new host record is from an anonymous label on a pin with a female of *C. moesta* from Tucson, Arizona: *M. concinna*.

DISTRIBUTION AND SEASON OF FLIGHT. The distribution of *Coelioxys moesta* is practically the same as that of *C. funeraria* (compare Figs. 20 and 30).

Coelioxys moesta is in flight at least

FIGURE 30. Distribution of *Coelioxys moesta*.

from May 27 (Virginia) to September 29 (Ontario, Canada).

HABITAT. The habitat of *Coelioxys moesta* agrees closely with that of *C. funeraria* with both bees taken at many of the same localities.

GEOGRAPHIC VARIATION. The variation in *Coelioxys moesta* described above does not seem to be related to geography.

COMPARATIVE COMMENTS. Females of *Coelioxys moesta* are probably most easily confused with dark females of *C. banksi* but differ in that the profile of the clypeus is straight in *C. moesta*. Males of *C. moesta* are probably most easily con-

fused with dark males of *C. banksi* but differ by the dorsal carina of the genal excavation which extends to the preoccipital carina in *C. moesta*. Both sexes of *C. moesta* differ from all others in this group by the prothoracic tubercles which are *not* produced into a thin, almost translucent carina. Axillae of both sexes are shorter than those of other species in this group. The prothoracic tubercles and axilla of *C. moesta* more closely resemble those of *C. funeraria* than those of other bees in the *rufitarsis* group. However, *C. moesta* possesses complete graduli on metasomal terga two and three (incomplete in *C. funeraria*).

Coelioxys novomexicana Cockerell

Figures 22E, 31

Coelioxys sayi novomexicana Cockerell, 1909, Entomol. News 20:9 (♀, New Mexico, type in University of Colorado Museum).

Coelioxys novomexicana; Crawford, 1914, Ann. Entomol. Soc. Amer. 7:149 (Key); Bechtel, 1958, Pan-Pacific Entomol. 34:12-13 (Host).

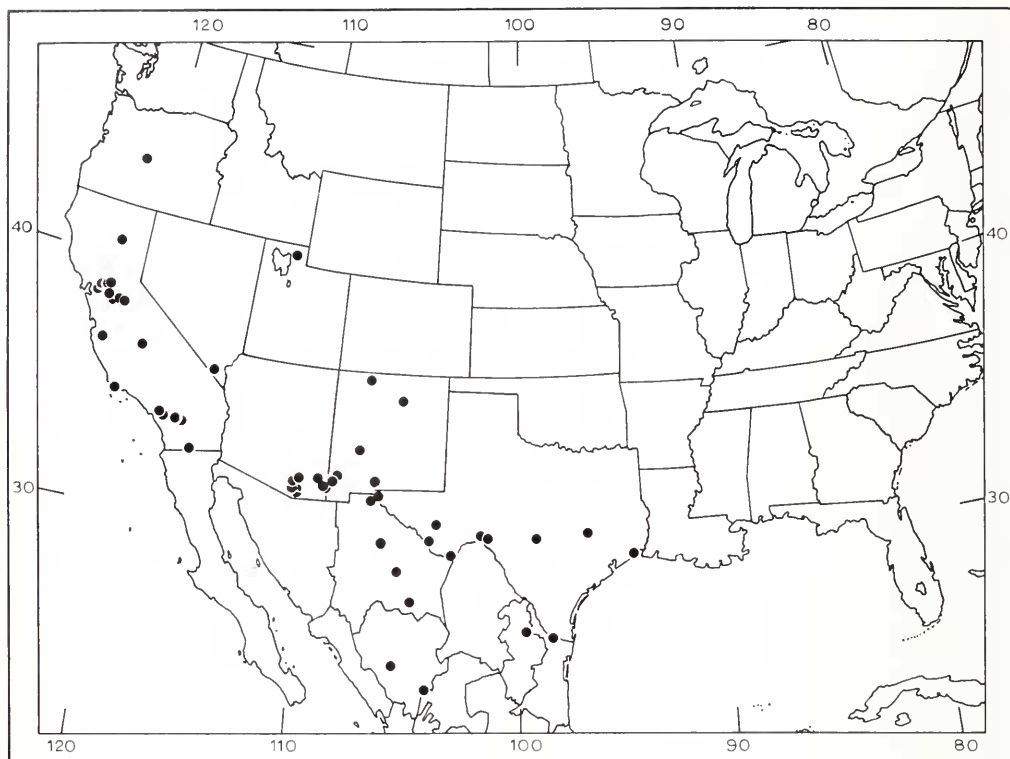
Coelioxys texana; Bohart, 1970, Utah State Univ. 41st Faculty Honor Lecture, p. 8 (Misidentification).

FEMALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (1) Length 8-13 mm; (2) integument black; scape, pedicel, and apical portions of metasomal sterna black to dark reddish-brown; apical portion of clypeus, tegula, and legs distal to trochanters ferruginous; (3) pubescence white; golden on tarsi; clypeus and face with scattered erect light brown setae; (4) ocular hairs short (about 0.05 mm long); (5) clypeus uniformly covered by short, appressed setae and scattered erect setae, margin produced into 2 lobes (Fig. 22E); (7) paracocular area obscured by setae about 0.2 mm long plus scattered erect setae; (8) rest of face rugose, closely punctured up to ocellar area, with or without a small median impunctate ridge; (10) ocellar area raised, impunctate to closely punctured; (11) interocellar distance subequal to ocellocipital, less than ocellocular distance; (12) vertex moderately punctate, usually with small impunctate area latero-posterior to ocelli; (13) gena practically obscured by prostrate setae; (14) hypostomal area of gena with setae equal in length to those on disc; (16) scutum with long erect setae on disc less conspicuous and anterior fascia more distinct than shown in Figure 21; (17) lateral surface of mesepisternum with setae shorter (about 0.15 mm) and sometimes squamose

on disc; (18) scutellum with posterior margin straight as in Figure 23C; (20) metanotal setae erect or prostrate medially; (21) front coxal spine acute, directed ventrally, inconspicuous; (22) tergum 6 angled as in Figure 24E-G; (23) sternum 6 ovate to broadly lanceolate as in Figure 24E-G.

MALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (25) Integument black; tegula, venter of metasoma brown; leg distal to coxae ferruginous; (26) pubescence white, golden on tarsi; (27) ocular hairs short (about 0.06 mm); (28) clypeus obscured by short (about 0.33 mm) setae; (30) paracocular area obscured by short setae (about 0.4 mm); (31) rest of face rugose, obscured by copious setae up to 0.2 mm long; (32) interantennal distance subequal to clypeoantennal distance, greater than antennocular distance; (33) ocellar area as in female (10 above); (34) ocellocipital and ocellocular distances subequal, greater than interocellar distance; (35) vertex as in female (12 above); (36) anterior portion of gena practically obscured by prostrate setae; (37) hypostomal area of gena with distinct excavation (as in Fig. 4), anterior and ventral portion of excavation with fascia shorter than setae on gena; dorsal carina of the excavation reaches preoccipital carina; (39) scutum as in female (16 above); (40) mesepisternum as in female (17 above); (41) scutellum as in female (18 above); (43) metanotum as in female (20 above); (45) fovea on tergum 2 about 0.03 mm long, about 0.13 mm wide (as in Fig. 25G); tergum 6 with dorsal spines variable: sometimes reduced, sometimes as in Fig. 25C, sometimes more slender than shown in Fig. 25C; (47) sternum 4 with apical emargination less conspicuous than shown in Fig. 26B; apical margin of sternum 5 straight, lateral setae more plumose than shown in Fig. 26B.

HOST RECORDS. Bechtel (1958) re-

FIGURE 31. Distribution of females of *Coelioxys novomexicana*.

ported males of *Coelioxys novomexicana* (See comparative comments for *C. novomexicana*.) emerged from a nest of *Megachile gentilis*. Another possible host is indicated by a bee collected by Dr. F. Werner at Tucson, Arizona, close to a nest of *M. sidalceae*. A third host bee is *M. brevis* from the labels of female *C. novomexicana* from three localities in California: Summerville, Sacramento, and Turlock. A fourth host record is from the labels of four small (8-10 mm) females from Davis and College City, California, where Dr. R. W. Thorp reared *C. novomexicana* from nests of *M. rotundata*.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys novomexicana* is most common in the southwestern United States and northern Mexico (Fig. 31).

Season of flight is at least from April 12 (Texas) to October 1 (southern California).

HABITAT. *Coelioxys novomexicana* ranges from various areas classified as western pine forests (*Pinus*) into areas classified as juniper-pine (*Juniperus*), oak-juniper (*Quercus*), mountain mahogany-oak (*Cercocarpus*) scrub and woodlands. In California *C. novomexicana* also has been taken from areas classified as chaparral (*Adenostoma*, *Archtostaphylos*, *Ceanothus*), coastal sagebrush (*Salvia*, *Eriogonum*), California steppe (*Stipa*), and tule marshes (*Scirpus*, *Typha*). Areas classified as creosote bush-bur sage (*Larrea*, *Fanseria*) and creosote bush-tarbrush (*Flourensia*), Trans-Pecos shrub savana, juniper-oak savana (with *Andropogon*) are more southerly vegetation types. This bee also occurs in areas classified as open habitats such as alpine meadows and barren (*Agrostis*, *Carex*, *Festuca*, *Poa*), and grama tobosa prairie and shrubsteppe (*Bouteloua*, *Hilaria*, *Larrea*). In the east-

ernmost portion of its range, *C. novomexicana* has been taken from an area classified as oak-hickory forest (*Carya*).

GEOGRAPHIC VARIATION. Size (using head width as an index) of females of *Coelioxys novomexicana* from central California was found to vary significantly from size of females outside this region. Head widths of 59 females from central California (3.06 ± 0.153 mm) were highly significantly less than the head widths of 125 females from the rest of the range (3.39 ± 0.186 mm). Perhaps, as was postulated for *C. funeraria* (p. 102), this difference in size is an expression of host size. The only evidence for this explanation is that three small females from Summerville, Sacramento, and Turlock, California were reared from nests of *Megachile brevis* whereas a large female was taken close to a nest of *M. sidalceae* in Tucson, Arizona. Since *M. sidalceae* (11-14 mm) is a larger bee than *M. brevis* (7-12 mm), the cells of *M. sidalceae* are doubtless larger and could support a larger parasite.

Females of *Coelioxys novomexicana* are smaller in size in central California, but in the same general area males have been taken which had earlier been considered to be *C. novomexicana* but which are larger than true *C. novomexicana*. It seems improbable that these males belong to the same species (assuming that *C. octodentata* and *C. novomexicana* are not the same species, see discussion under *C. octodentata*) as the smaller females. A more likely explanation is that these males belong to *C. octodentata*.

COMPARATIVE COMMENTS. Females of this species are most likely to be confused with *Coelioxys octodentata* although the females of *C. novomexicana* have the clypeal margin modified into two conspicuous lobes (Fig. 22E). The only other bee in this group possessing a bilobed clypeal margin is *C. sayi* from which

C. novomexicana differs by the fringe of setae on the clypeal margin which is directed ventrally (directed posteriorly in *C. sayi*). Males of *C. novomexicana* are most likely to be confused with males of *C. octodentata* from which they are separable only by distribution (where the distributions of the females do not overlap). Males of *C. sayi* are similar but in *C. sayi* the posterior margin of the gradular groove on the third metasomal tergum is almost obliterated medially (distinct in *C. novomexicana*). In the southern extreme of their range, males of *C. novomexicana* may be confused with males of *C. pratti* from which they differ by their short ocular hairs (long in *C. pratti*).

Coelioxys oaxacana, new species

Figures 23C, 24K

FEMALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (1) Length 12.5 mm; (2) integument black; mandible rufous medially; legs, tegula ferruginous; (3) pubescence white, ochreous on face, golden on tarsi; (4) ocular hairs short (about 0.06 mm); (5) clypeus hidden by appressed setae about 0.15 mm long, margin obscured by dense fringe 0.45 mm wide medially; margin widely emarginate; (6) paraocular area hidden by setae about 0.2 mm long; rest of face visible between short, appressed setae, strongly punctured, broadly conical; (9) clypeoantennal distance subequal to interantennal distance, greater than antennocular distance; (10) ocellar area with impunctate median longitudinal line anteriorly; (12) vertex sparsely punctured anteriorly, moderately punctured posteriorly; (14) hypostomal area of gena with setae shorter than those on gena; (16) scutum with fasciae more distinct than shown in Figure 21; (17) lateral surface of mesepisternum moderately punctured with many more very small punctures than larger punctures;

disc with very short, scattered, slendered setae; distinct fasciae anteriorly and posteriorly; (18) scutellum with median longitudinal impunctate line (Fig. 23C); (19) axilla slender, acute (Fig. 23C); (22) terga 2, 3 with gradular grooves complete but almost obliterated medially; tergum 6 elongate (Fig. 24K).

COMPARATIVE COMMENTS.

Coelioxys oaxacana is distinguished from all other females in this group by the broadly conical condition of the ventral portion of the rest of the face; the divergent, acute axillae (Fig. 23C); and the elongate, conspicuously angled sixth metasomal tergum (Fig. 24K).

TYPE. Holotype female, ten miles southeast Tapanatepec, Oaxaca, Mexico, August 8, 1963 (F. D. Parker, L. A. Stange) in the collection of the University of California, Davis.

Coelioxys octodentata Say Figures 24D-I, 25G, 32

Coelioxys octodentata Say, 1824, *In* Keating, Narrative of Long's 2nd Expedition etc. 2:353 (♂, type probably destroyed); Say, 1837, Boston J. Nat. Hist. 1:400 (♀); Robertson, 1897, Trans. St. Louis Acad. Sci. 7:345 (= *C. atilis*, = *C. brevis*); Fox, 1900, Entomol. News 11:553 (Host); Hicks, 1926, Univ. Colorado Stud. 15:22 (Biology); Robertson, 1926, Psyche 33:116 (Host); Robertson, 1929, Flowers and Insects, Lancaster Pennsylvania Sci. Press 9:217 (Flower records); Graenicher, 1935, Ann. Entomol. Soc. Amer. 28:300, 304 (Host, Wisconsin); Michener, 1953, Univ. Kansas Sci. Bull. 35: 1059-1060, 1737-1742 (Biology); Linsley, 1958, Hilgardia 27:582 (Ecology); Medler, 1965, Proc. Entomol. Soc. Washington 67:113-115 (Biology); Stephen, Bohart and Torchio, 1969, Biology and External Morphology of Bees:

- 29 (Immatures); Baker, 1971, J. Kansas Entomol. Soc. 44:225-235 (Immatures).
Coelioxys brevis Cresson (nec Eversmann), 1864, Proc. Entomol. Soc. Philadelphia 2:402-403, (♀, Connecticut, New Jersey, Pennsylvania, Maryland, type # 2490 in the Academy of Natural Sciences of Philadelphia).
Coelioxys atilis Cresson, 1878, Trans. Amer. Entomol. Soc. 7:219 (new name for *C. brevis* Cresson, not Eversmann).
Coelioxys cressoni Dalla Torre, 1896, Catalogus Hymenopterorum 10:485 (new name for *C. brevis* Cresson, not Eversmann).
Coelioxys coquillettii Crawford, 1914, Ann. Entomol. Soc. Amer. 7:157 (♀, California, type # 18224 in the National Museum of Natural History) NEW SYNONYMY.
Coelioxys megatracha Cockerell, 1916, J. Entomol. Zool. 8:60 (♂, California, type in the American Museum of Natural History) NEW SYNONYMY.
Coelioxys crassula Cockerell, 1919, Can. Entomol. 51:27 (♀, Colorado, type in the American Museum of Natural History) NEW SYNONYMY.
Coelioxys mediata Cockerell, 1925, Pan-Pacific Entomol. 1:146-147 (♀, California, type # 1634 in the California Academy of Sciences) NEW SYNONYMY.
Coelioxys atlantica Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:193, 195, 198 (♀, ♂ Canada to Florida in the eastern United States, type in the collection of T. B. Mitchell) NEW SYNONYMY.
- FEMALE. Agrees with descriptions and figures of *Coelioxys rufitarsis* and *C. novomexicana* except as follows: (1) Length 7-12 mm; (2) integument black; scape, pedicel, apical portions of metasomal sterna black to dark ferruginous; tegula, tibiae, tarsi fulvous; femora black to fulvous; (5) clypeus slightly convex,

clypeal margin straight or slightly emarginate as in Figure 22B; (22) tergum 6 with lateral angles variable (Fig. 24D-I); (23) sternum 6 with apex variable, broadly ovate to lanceolate (Fig. 24D-I).

MALE. Agrees with descriptions and figures of *Coelioxys rufitarsis* and *C. novomexicana* except as follows: (45) tergum 6 with dorsal spines usually slightly more slender than shown in Figure 25G.

HOST RECORDS. Fox (1900) reared *Coelioxys octodentata* from a nest of *Megachile mendica*, a record repeated later by Medler (1965). Hicks (1926) reared *C. octodentata* from a nest of *M. brevis*, repeated later by Michener (1953) and Baker (1971). Medler (1958) reared this bee from a nest of *M. centuncularis*, and Hobbs (1956) reared it from a nest of *M. perihirta*. Medler and Lussenhop (1968) reported that D. H. Pengelly reared *C. octodentata* from a nest of *M. texana*. A new host record is a female of *C. octodentata* labeled: Cornish, Utah, IX-10-59, reared from cell of *Meg. onobrychidis*. Another new host record is from three females from College City, California reared from three nests of *M. rotundata* by Dr. R. W. Thorp (as would be expected, these bees are small, 7-8.5 mm).

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys octodentata* ranges from southern Canada to the southern United States (Fig. 32). In the southwestern portion of its range the distribution of *C. octodentata* overlaps with that of *C. novomexicana* (compare Figs. 31 and 32).

This bee is in flight at least from May 8 (Kansas) to October 22 (central California).

HABITAT. In the western United States, *Coelioxys octodentata* has been collected from a variety of areas classified as needleleaf forests and broadleaf and needleleaf forest combinations. This bee has also been taken from a number of western

shrub lands, western grasslands and western shrub and grassland combinations. Elsewhere this bee has been taken from central and eastern grasslands, grassland and forest combinations, and eastern broadleaf and broadleaf and needleleaf forests.

However, more specific habitat observations have been reported for *Coelioxys octodentata* (Hicks, 1926; Michener, 1953). The host bee, *M. brevis*, nests in open meadows and unshaded sites usually in, on or near the ground. These are also types of areas in which *C. octodentata* is found flying near the ground and from which nests containing *C. octodentata* larvae have been recovered (Hicks, 1926; Michener, 1953). Occasionally *M. mendica* nests in the ground at the edges of open areas, a situation which *C. octodentata* might exploit.

GEOGRAPHIC VARIATION. Six characters of *Coelioxys octodentata* were analyzed for geographic variation: size, degree of angulation of the sixth tergum, density of the medial fascia of the first metasomal tergum, leg color, punctuation of the vertex, and degree of elongation of the sixth metasomal sternum. Females were used for this analysis as the males in southern Oregon, California, northern Arizona and New Mexico, Utah, and Colorado cannot be distinguished from those of *C. novomexicana*. In Figure 32 each of the six sides of a symbol summarizes data on one character in the form of a histogram for the group of bees from the area indicated (a key to characters and scale appears in the upper right portion of the map).

Size varies markedly even in bees from the same general area (in Fig. 32 size was scored as small, 0-9.0 mm; medium, 9.1-10.9 mm; large, 11-12 mm). Perhaps, as was postulated for *Coelioxys funeraria* and *C. novomexicana*, size is an expression of host size in *C. octodentata*.

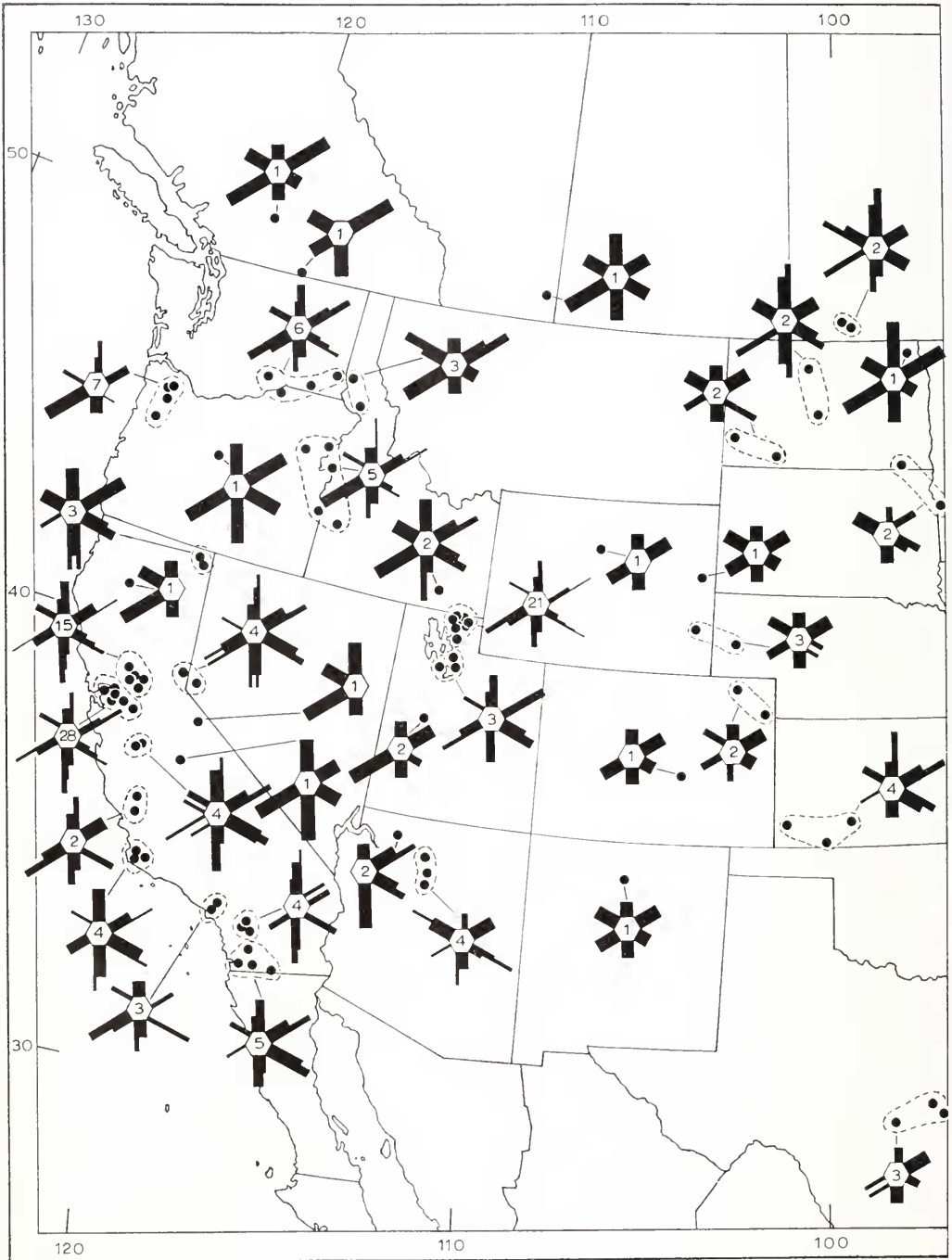


FIGURE 32. Distributions of females of *Coelioxys octodentata* showing variation of six characters given in (upper right) key.

Degree of development of the lateral angle of the apical tergum does not seem to vary geographically except perhaps for

bees from the Southeast. Bees from the East with well developed angles and apical sterna were formerly considered to be

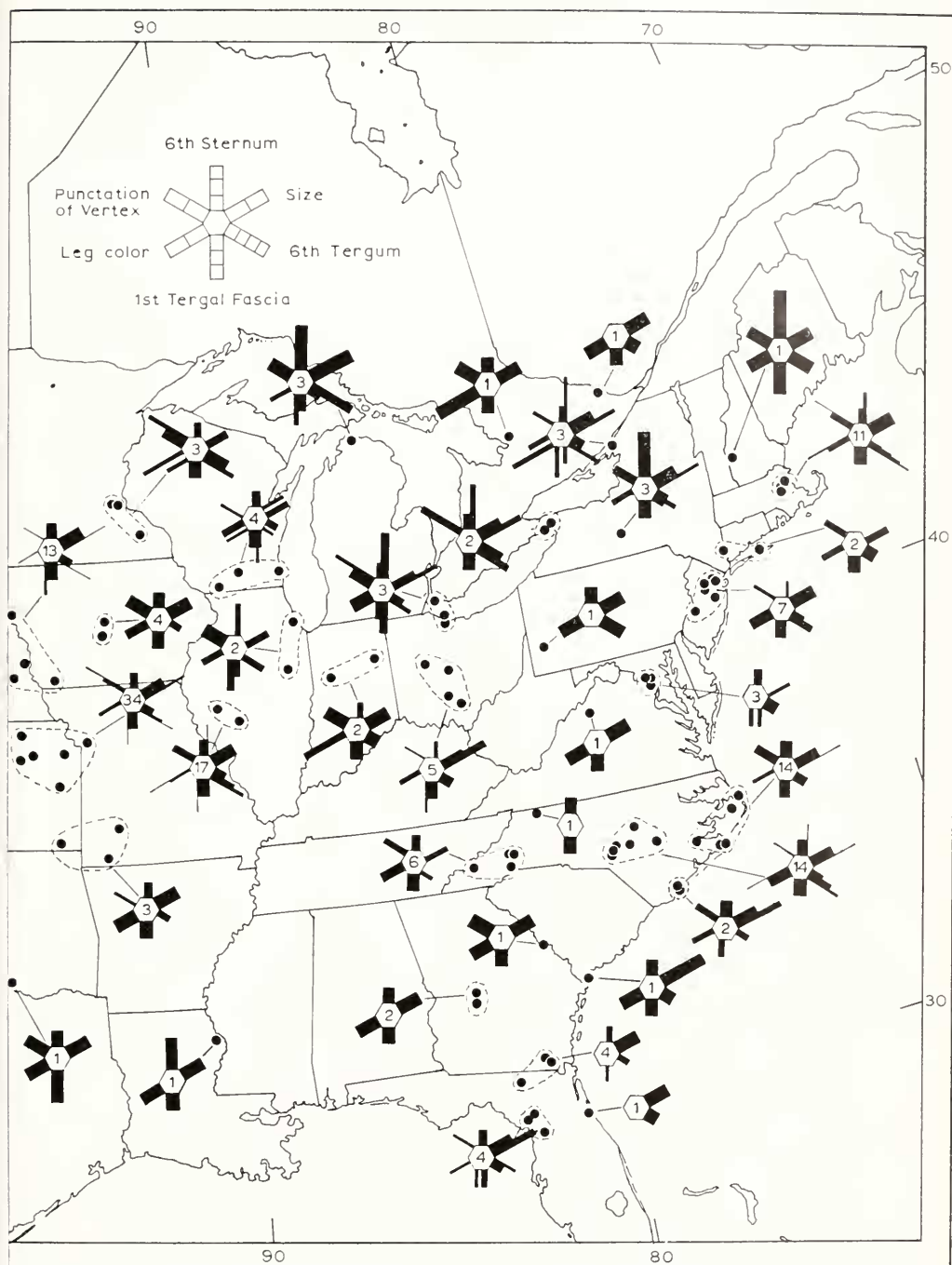


FIGURE 32. (continued) Each side of the hexagon is the base line of a histogram. The number inside each hexagon is the number of specimens examined from the area indicated.

Coelioxys atlantica. Bees from the West with well developed angles and apical sterna and medial fasciae of the first meta-

somal tergum were considered to be *C. coquilletti*. Bees intermediate in all conditions were considered to be *C. octo-*

dentata throughout the distribution. Bees, especially small specimens, with poorly developed sixth tergal angles, apical sterna, and medial fasciae were formerly considered to be *C. salinaria* or *C. pratti* (a misidentification; original description of *C. pratti* emphasizes the long, brown ocular hairs). Specimens with poorly developed angles and long sterna and specimens with extreme angles and short sixth sterna (Fig. 24D-I) represent mixed conditions among the extreme examples. Most bees from the Southeast have the lateral angles moderately developed (Fig. 32).

The medial fascia of the first metasomal tergum in general is poorly developed in the Southeast (minimum in Fig. 32) but well developed in large specimens from the northwestern and western United States (maximum in Fig. 32). In the West there seems to be a correlation between size and density of this medial fascia in that larger bees (formerly considered to be *Coelioxys coquilletti*) usually have medial fasciae which are more dense and contain more squamose setae than those of smaller bees (formerly considered to be *C. crassula* and *C. octodentata*). However, if only the larger bees are considered, the medial fascia of the first metasomal tergum gradually becomes less dense and the proportion of squamose setae drops as a cline across the northern United States from west to east.

Leg color, especially color of the femora, varies from black to fulvous with the color of most specimens intermediate (ferruginous). Bees of the eastern United States have fulvous to ferruginous legs whereas western specimens vary from fulvous to black with both large and small bees displaying both extremes of leg color.

Punctuation of the vertex varies from closely punctate to a condition in which impunctate areas occur lateroposteriorly to the ocelli (in Fig. 32 this character was scored as impunctate areas, minimum;

closely punctured, maximum). Most bees were intermediate or with impunctate areas, but a few (mainly from the North-east) were closely punctured.

The apex of the female sixth sternum seemed to be highly variable in contrast to most species of North American *Coelioxys* in which the apex of the sixth sternum may be uniform throughout the whole series. In *C. octodentata*, however, the apex of the sixth sternum ranged from broadly ovate (Fig. 24I, minimum in Fig. 32) to lanceolate (Fig. 24D, maximum in Fig. 32).

Females with maximum lanceolate apices of the sixth metasomal sternum were generally medium to large, although some small bees had moderately lanceolate apices (as in Fig. 24G-H).

COMPARATIVE COMMENTS. The large specimens of this species are most likely to be confused with *Coelioxys rufitarsis* although the ocular hairs are short and the medial fascia of the first metasomal tergum is composed of short, appressed setae in *C. octodentata* (long ocular hairs and long, erect setae on tergum one in *C. rufitarsis*). In the West, females of *C. octodentata* differ from those of *C. novomexicana* by their almost straight clypeal margin (bilobed in *C. novomexicana*) although males of *C. octodentata* are not separable from those of *C. novomexicana*. Females of *C. octodentata* differ from females of *C. sayi* in the same way as from females of *C. novomexicana* and males differ from *C. sayi* by the well produced posterior margins of the gradular grooves of metasomal terga two and three (posterior gradular margin almost obliterated medially in males of *C. sayi*).

Coelioxys porterae Cockerell
Figures 22F, 24J, 25F, 33

Coelioxys (lucrosa var?) porterae Cockerell, 1900, Can. Entomol. 32:297-301
(♀, ♂, New Mexico, key, type #

20230 in the National Museum of Natural History).

Coelioxys porterae; Cockerell, 1904, Ann. Mag. Natur. Hist. (7) 13:34 (at flowers of *Fraseria* sp.).

Coelioxys dubitata melanopoda Viereck, 1916, Connecticut Geol. Hist. Surv. Bull. 22:747 (δ , Connecticut, type # 66187 in the National Museum of Natural History); Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:220 (= *C. rufitarsis*, misidentification).

Coelioxys hypodonta Cockerell, 1925, Pan-Pacific Entomol. 1:150-151 (δ , California, type # 1637 in the California Academy of Sciences) NEW SYNONYMY.

FEMALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (1) Length 9-14.5 mm; (2) integument granular on vertex between punctures, rugulose on thorax, faintly rugulose on metasoma; black; tegula, venter of metasoma black to piceous; (3) pubescence white to faintly brownish on clypeus; (4) ocular hairs of medium length (about 0.1 mm); (5) clypeus also with erect setae (about 0.16 mm long) scattered on surface; (7) paraocular area obscured laterally by setae up to 0.4 mm long; (11) ocellocipital distance slightly greater than interocellar distance and much less than ocellocular distance; (13) gena with ventral angle less than 90° ; (14) hypostomal area of gena with setae subequal to setae on disc; (15) mandible with hump on middle of outer surface (Fig. 22F); (18) scutellum with posterior margin of dorsal surface slightly less rounded than shown in Figure 21; (19) axilla as or slightly less produced than shown in Figure 21; (20) metanotal setae erect; (22) terga 2 and 3 posterolaterally less closely punctured than shown in Figure 21; tergum 6 less conspicuously angled

than shown in Figure 21 (Fig. 24J); sternum 6 lanceolate apically (Fig. 24J).

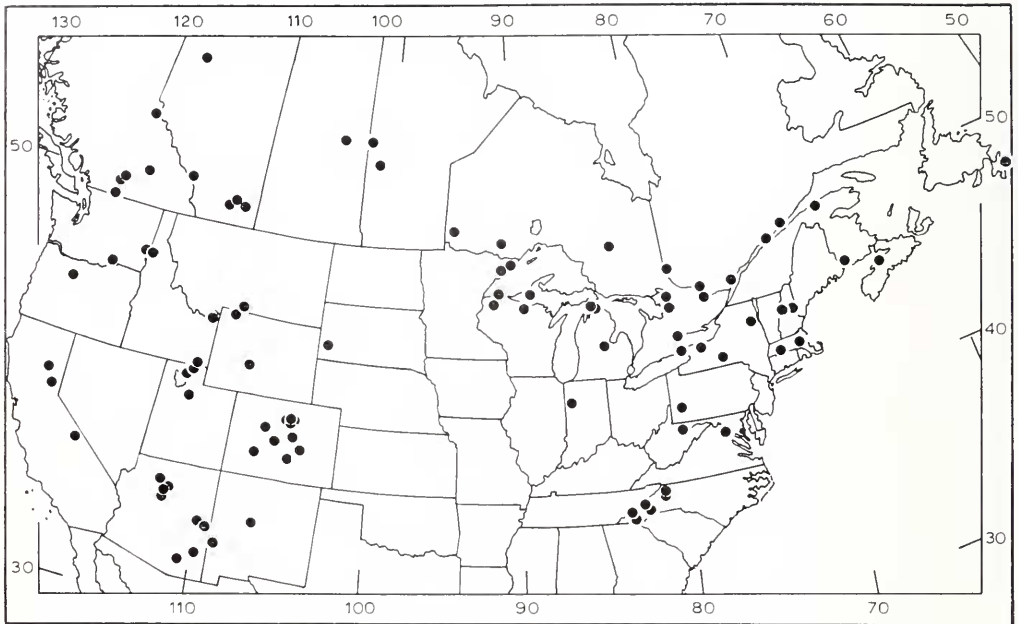
MALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (24) Length 9-12 mm; (25) integument black; tegula, legs distal to coxae, venter of metasoma black to piceous; (26) pubescence white, golden on tarsi; (27) ocular hairs of medium length (about 0.13 mm); (28) clypeus obscured by copious setae about 0.5 mm long; (31) rest of face closely punctured up to ocellar area, almost obscured by setae up to 0.7 mm long; (37) hypostomal area of gena with setae on anterior portion of excavation shorter than on disc; (41-43) scutellum, axilla, metanotum as in female (18-20 above); (45) terga 1-5 with apical fascia sparse but complete; gradular grooves of terga 5 and 6 fasciate; fovea on tergum 2 about 0.1 mm long, about 0.25 mm (Fig. 25E); dorsal spines of sternum 5 with denticles slightly more conspicuous than shown in Fig. 25C.

HOST RECORDS. Mitchell (1962) listed *M. relativa* as a host of *C. porterae*. A bee from Pibrach, Alberta was reared from the nest of *M. frigida* by Dr. G. A. Hobbs. Hobbs also collected two females at a log in which *M. frigida* was nesting in Scandia, Alberta.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys porterae* ranges across southern Canada and down the major mountain ranges of the United States (Fig. 33).

This bee is in flight at least from June 1 (Massachusetts) to September 9 (Medicine Hat, Alberta).

HABITAT. In the Southwest *C. porterae* occurs only at higher elevations in areas classified as various western needleleaf forests. From central California northward it occurs in areas classified as western needleleaf forests and western shrub and grasslands. In the Northeast and mountains of the Southeast, *C. porterae*

FIGURE 33. Distribution of *Coelioxys porterae*.

occurs in areas classified as eastern needle-leaf and broadleaf forests and combinations of these two vegetation types.

GEOGRAPHIC VARIATION. The variation described above does not seem to be related to geography.

COMPARATIVE COMMENTS. *Coelioxys porterae* is most likely to be confused with dark specimens of *C. octodentata* from which it can be distinguished by the medium length of the ocular hairs (short in *C. octodentata*) in females and the larger fovea of the second metasomal tergum (Fig. 25F) in males (small in *C. octodentata*, Fig. 25G). Another similar bee is *C. sodalis* which has long ocular hairs and no subapical notches on the sixth sternum in the female and no foveae on the second tergum in the male.

Coelioxys pratti Crawford
Figure 34

Coelioxys pratti Crawford, 1914, Ann. Entomol. Soc. Amer. 7:159 (♀, Texas, type # 18225 in the National Museum of Natural History).

FEMALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (1) Length 9.5-13 mm; (2) integument black; tegula, legs ferruginous to fulvous; lateral margins of metasomal terga 1 and 2, posterior areas of sterna 2-5 ferruginous; (3) pubescence white, brownish tinge on face and thorax; ocular hairs light brown; golden on tarsi; (4) ocular hairs medium to long (about 1.3 mm); (5) clypeus uniformly covered with short appressed setae and erect brown setae (about 0.25 mm long); (7) paraocular area obscured laterally by setae about 0.3 mm long; (11) interocellar and ocellocipital distances subequal, less than ocellocular distance; (12) vertex slightly more closely punctured than shown in Figure 21; (13) gena with ventral angle slightly less than 90°; (15) mandible with hump on outer surface slightly less conspicuous than shown in Figure 22F; (16) scutum with anterolateral fascia more conspicuous and erect setae on disc less conspicuous than shown in Figure 21; (18) scutellum with posterior margin less rounded than

shown in Figure 21; (20) metanotum with erect setae; (22) tergum 6 not as angled laterally as shown in Figure 21, more like Figure 24J.

MALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (24) Length 9-11 mm; (25) integument as in female (2 above), terga 2-4 with lateral margins ferruginous; (26) pubescence as in female (3 above); (27) ocular hairs long (about 0.15 mm); (28) clypeus obscured by copious long (about 0.5 mm) setae; (30) paraocular area obscured laterally by long (up to 0.6 mm) setae; (31) rest of face rugose with long (up to 0.6 mm) setae sometimes obscuring integument; (34) ocelloccipital distance greater than interocellar distance, less than ocellocular distance; (35) vertex as in female (12 above); (36) gena as in female (13 above); (37) hypostomal area of gena

with anterior fascia of excavation shorter than genal setae; (39) scutum as in female (16 above); (41) scutellum as in female (18 above); (43) metanotum as in female (20 above); (45) fovea on tergum 2 about 0.05 mm long, about 0.1 mm wide as shown in Figure 25G; (47) margin of sternum 5 slightly emarginate; sternum 8 with setae longer, more abundant than shown in Figure 26E; genital armature with copious, long (half the length of gonocoxite) setae on gonocoxite.

DISTRIBUTION AND SEASON OF FLIGHT. Although the type was collected in Texas, most specimens of *Coelioxys pratti* were taken in Mexico and southward (Fig. 34).

Coelioxys pratti is in flight from at least March 21 (Cuernavaca, Morelos) to December 24 (Tamazunchale, San Luis Potosi).

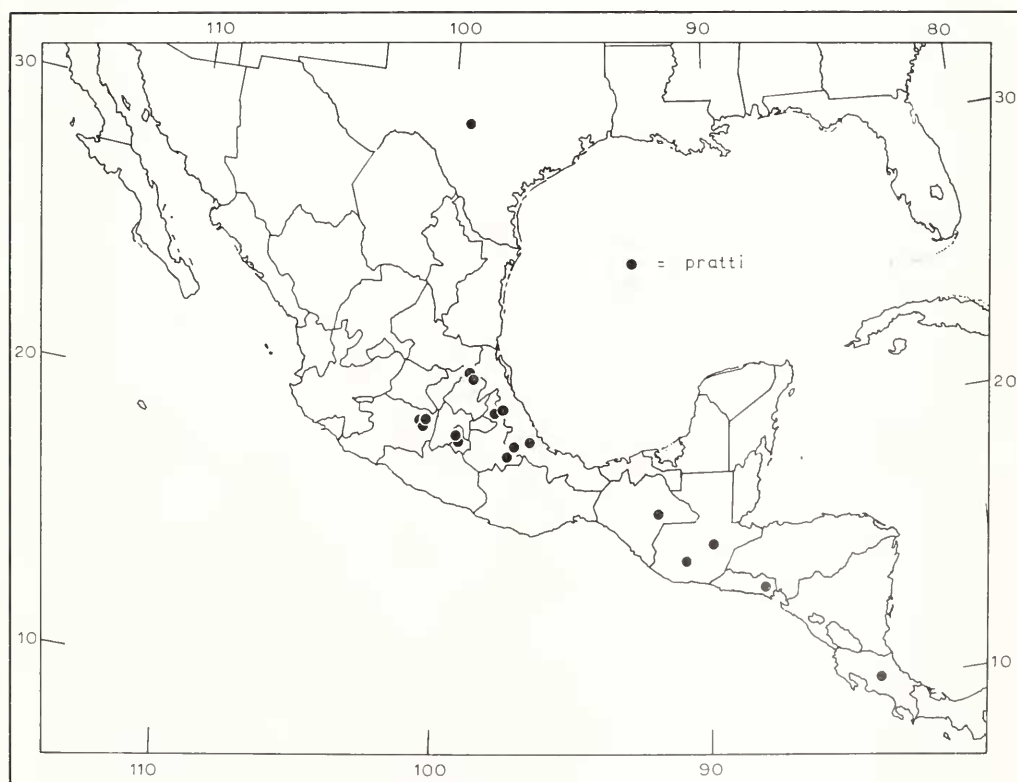


FIGURE 34. Distribution of *Coelioxys pratti*.

HABITAT. The type locality (Kerrville, Texas) is in an area classified as juniper-oak savana (*Juniperus*, *Quercus*, *Andropogon*). The remaining localities are at least 600 miles farther south and at elevations above 1,000 feet.

COMPARATIVE COMMENTS. Both sexes of *Coelioxys pratti* are most similar to *C. octodentata* but can be distinguished by the long, brown ocular hairs (short and yellowish to white in *C. octodentata*).

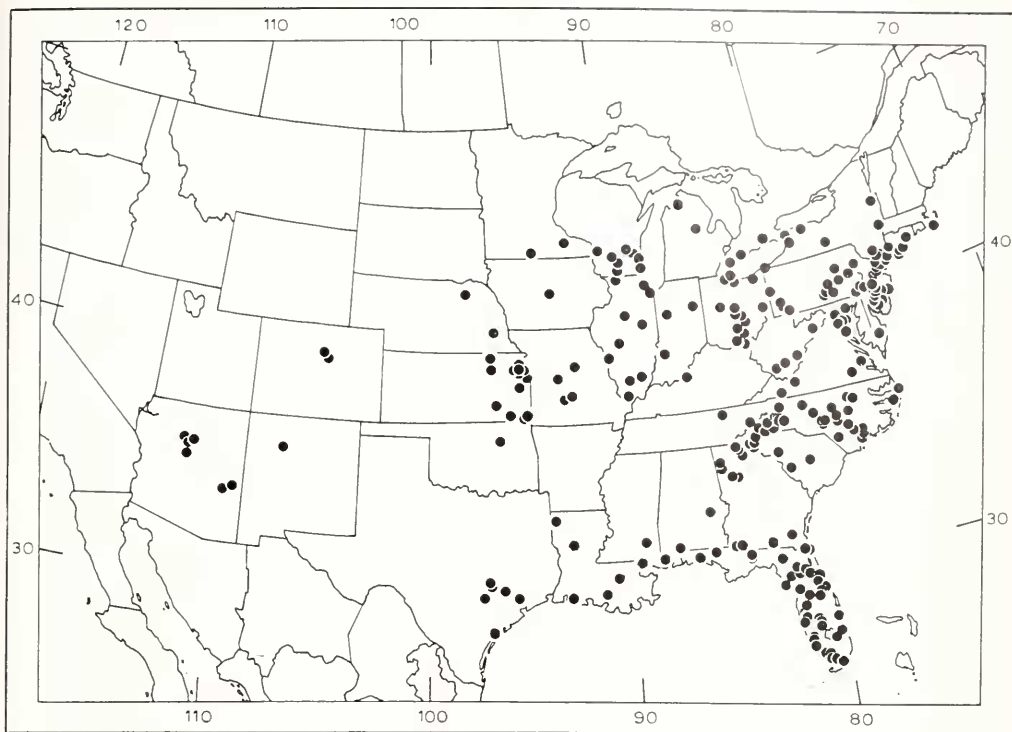
Coelioxys sayi Robertson
Figures 22G, 35

Coelioxys sayi Robertson, 1897, Trans. Acad. Sci. St. Louis 7:346 (♀, ♂, Florida, Illinois, type in the Illinois Natural History Survey); Robertson, 1926, Psyche 33:116 (Host); Robertson, 1929, Flowers and Insects, Lancaster Pennsylvania Science Press, p. 9-216 (Flower records); Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152: 192, 195, 222 (Key, redescription, = *C. mendacina*); Medler, 1965, Proc. Entomol. Soc. Washington 67:113-115 (Host); Krombein, 1967, Trap-nesting Wasps and Bees, Smithsonian Press, P. 322 (Host); Baker, 1971, J. Kansas Entomol. Soc. 44:225-235 (Immatures).
Coelioxys mendacina Cockerell, 1921, Amer. Mus. Novitates 21:3, 7 (♀, Virginia, type in the American Museum of Natural History).

FEMALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (1) Length 9.5-12 mm; (2) integument granular on vertex between punctures, less so on thorax; (3) pubescence white, slight golden-brown tinge on clypeus, golden on tarsi; (4) ocular hairs of medium length (about 0.08 mm); (5) clypeus covered with short appressed setae plus scattered erect setae; surface visible, margin thickened and slightly bilobed

(Fig. 22G); (7) paraocular area almost obscured by appressed and erect setae about 0.2 mm long; (8) rest of face rugose with long (0.45 mm) mediosagittal impunctate ridge extending from ocellar area; (9) clypeoantennal distance subequal to antennocular distance and less than interocellar distance; (10) ocellar area coarsely punctured; (14) hypostomal area of gena with setae subequal to setae on disc; (15) mandible with outer margin straight (Fig. 22G); (16) scutum with erect setae shorter and less conspicuous than shown in Figure 21; (17) lateral surface of mesepisternum moderately punctured with short (0.2 mm) slender setae on disc and distinct anterior and posterior fasciae; (18) scutellum with posterior margin less rounded than shown in Figure 21; (20) metanotal setae sometimes erect, sometimes prostrate medially; (22) tergum 3 with gradular groove medially, fasciae on terga 1-5 not as conspicuous as shown in Figure 21; tergum 6 with lateral angles as shown in Figure 24H.

MALE. Agrees with description and figures of *Coelioxys rufitarsis* except as follows: (24) Length 9-10 mm; (26) pubescence as in female (3 above); (27) ocular hairs short (about 0.8 mm); (28) clypeus obscured by long, copious setae (about 0.3 mm); (30) paraocular area obscured by copious setae (about 0.3 mm long); (31) rest of face rugose, punctured closely up to ocellar area, with copious setae (about 0.3 mm long); (33) ocellar area as in female (10 above); (34) ocelloloccipital distance greater than interocellar distance, less than ocellocular distance; (35) vertex usually with impunctate areas lateroposterior to ocelli; (36) gena with ventral angle about 90°; (37) excavation of hypostomal area of gena with setae of anterior fascia shorter than setae on disc; (39-43) scutum, mesepisternum, scutellum, axilla, metanotal setae as in female (16-20 above); (45) gradular grooves of

FIGURE 35. Distribution of *Coelioxys sayi*.

terga 2, 3 as in female (22 above); fovea on tergum 2 about 0.03 mm long; 0.06 mm wide (as in Fig. 25G); dorsal spines of tergum 6 variable, sometimes more, as, or less slender than shown in Figure 25C; (47) genital armature with setae not as abundant on gonocoxite apically as shown in Figure 26F.

HOST RECORDS. Medler (1965) reported *Megachile mendica* to be a host of *Coelioxys sayi*. This bee has also been recovered from nests of *M. brevis*.

DISTRIBUTION AND SEASON OF FLIGHT. Except for scattered records from the West, *Coelioxys sayi* is confined to the eastern United States (Fig. 35).

This bee is in flight from at least March 3 in Florida, April 30 in Texas, and May 8 in Kansas to October 3 in New York and October 23 in Texas.

HABITAT. In the eastern United States, *Coelioxys sayi* has been collected from areas classified as eastern broadleaf,

eastern broadleaf and needleleaf forests, and eastern grassland and forest combinations. In the West, *C. sayi* has been taken from areas classified as western needleleaf forests. However, as with *C. octodentata*, more specific habitats have been reported for its host *Megachile mendica*, as well as for *C. sayi* (Medler, 1965). These bees have been reared from trap nests placed in open woodland, savana, and forest-edge habitats. The nests usually occur well above the ground (although *M. mendica* has been observed to nest in the ground). *C. sayi* has been taken from *M. brevis* nests at ground level, and has been observed at a woodland edge flying slowly along the ground as though searching for host nests.

GEOGRAPHIC VARIATION. As in the case of *Coelioxys alternata*, leg color in *C. sayi* does not seem to be meaningfully correlated to geography. Bees with all degrees of leg color occur at many lo-

calities throughout the range, and the chance of finding any particular condition at a given location appears to hinge on the sample size rather than latitude and longitude. As with *C. texana*, however, wing color does vary geographically. Bees from Florida to Texas have slightly darker, very slightly more yellowish wings than those from elsewhere in the distribution.

COMPARATIVE COMMENTS. Females of *Coelioxys sayi* are most similar to those of *C. rufitarsis* and *C. octodentata* although the clypeus is bilobed in *C. sayi* and straight in the other two species. In the West, *C. sayi* might be confused with dark females of *C. novomexicana* but differs conspicuously in the setal fringe of the clypeus which is posteriorly directed (ventrally directed in *C. novomexicana*). Males of *C. sayi* are most easily confused with those of *C. octodentata*, differing mainly in the reduced posterior margins of the gradular grooves of terga two and three (well formed in *C. octodentata*).

Subgenus *Xerocoelioxys* Mitchell

Xerocoelioxys Mitchell, 1973. A subgeneric revision of the genus *Coelioxys* of the Western Hemisphere. Cont. Dept. Entomol. North Carolina State Univ. p. 44. Type species: *Coelioxys edita* Cresson.

Xerocoelioxys is intermediate between *Boreocoelioxys* and the subgenus *Coelioxys*. The distinct foveae of males of *Boreocoelioxys* are represented in some members of *Xerocoelioxys* by densely punctate foveal areas. The notched sixth sternum of females of *Boreocoelioxys* is also found in one species of *Xerocoelioxys* although the configuration is not exactly reproduced (compare Figs. 21 and 38B). The subgenus *Coelioxys* is separable from *Xerocoelioxys* by the reduced fasciae of the mesosoma and metasoma and by the reduced carina of the prothoracic tubercles.

Bees in *Xerocoelioxys* fall clearly into two subgroups: (1) *Coelioxys edita*, *C. boharti*, *C. mesae*, *C. galactiae*, *C. grindeliae*, *C. nodis*, *C. piercei*, and *C. soror*; and (2) *C. aperta* and *C. bisoncornua*. Reasons for this subdivision

are given under the comparative comments for *C. aperta*.

Host records are known for two species, *Coelioxys mesae* and *C. grindeliae* (Table 1), and the host bees fall into two subgenera of *Megachile*.

Most of the characters in the list below are found in other subgenera of New World *Coelioxys* and even in some of the Old World *Liethyrapis*, but never in this combination. Italicized characters most clearly differentiate *Xerocoelioxys* from other subgenera in North America.

A. Ocellar area variously punctured.

B. Preoccipital carina complete or incomplete medially.

C. Mandible robust, variously modified (Fig. 36A-C).

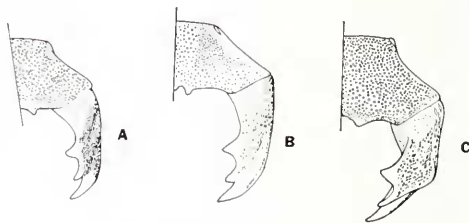


FIGURE 36. Left half of clypeus and mandible of females of *Xerocoelioxys*. A, *C. edita*; B, *C. aperta*; C, *C. bisoncornua*.

D. *Prothoracic tubercle with carina produced into thin, plate-like structure.*

E. *Scutum moderately to closely punctured, with conspicuous fasciae.*

F. *Scutellum closely punctured* (Fig. 37A-E).

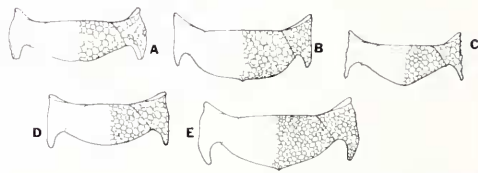


FIGURE 37. Scutellum and axillae of females of *Xerocoelioxys*. A, *C. edita*; B, *C. aperta*; C, *C. grindeliae*; D, *C. soledadensis*; E, *C. bisoncornua*.

G. *Axillae well produced* (Fig. 37A-E).

H. *Mesepisternum with lateral surface moderately to closely punctured, with distinct fasciae.*

I. *Graduli complete on metasomal terga two and three.*

J. *Female: fore coxal spine variable.*

K. Female: sixth metasomal sternum with apical margin straight or constricted (notched in *Coelioxys bisoncornua*, Fig. 38B) as in Figures 42A and 38A.

L. Male: hypostomal area of gena with excavation (Fig. 6).

M. Male: foveal area of metasomal tergum two densely punctured in some species.

N. Male: fifth metasomal tergum with lateral spine.

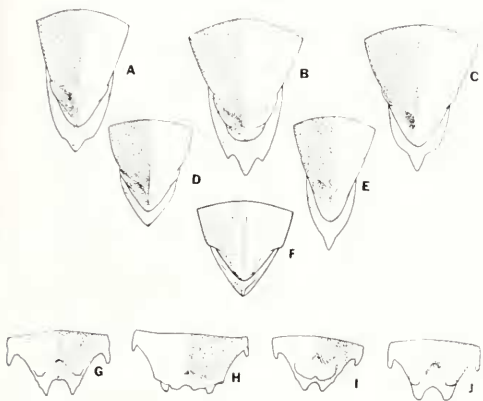


FIGURE 38. A-F, Sixth metasomal tergum and sternum of females of *Xerocoelioxys*. A, *C. edita*; B, *C. bisoncornua*; C, *C. galactiae*; D, *C. soledadensis*; E, *C. grindeliae*; F, *C. piercei*. G-J, Sixth metasomal tergum of males of *Xerocoelioxys*. G, *C. edita*; H, *C. aperta*; I, *C. soledadensis*; J, *C. nodis*.

O. Male: sixth metasomal tergum with dorsal spines variable, reduced in some species (Fig. 38G-J).

P. Male: seventh metasomal tergum variable apically.

Q. Male: apex of metasomal sternum four conspicuously emarginate (Fig. 39R).

R. Male: sternum seven represented by two small sclerites (Fig. 39B).

KEY TO FEMALES OF *Xerocoelioxys*

1. Fore coxal spine reduced to obtuse angle 2
Fore coxal spine conspicuous, directed anteriorly or ventrally 3
2. Mandible with distinct flange on outer surface (Fig. 36C); ocular hairs very short (about 0.03 mm) *bisoncornua*
Mandible without distinct flange on outer surface (Fig. 36B); ocular hairs short (about 0.06 mm) *aperta*

3. Sixth metasomal tergum with distinct subapical protrusions (Fig. 38F)
Sixth metasomal tergum without protrusions 4
4. Sixth metasomal sternum elongate, constricted subapically (Fig. 38E); legs black to picaceous; gena usually hidden by dense setae; scutellum sometimes with raised longitudinal median line
..... *grindeliae*
Sixth metasomal sternum variable, if elongate then legs ferruginous; gena visible through subappressed setae; scutellum without longitudinal medial line 5
5. Sixth metasomal sternum not or little constricted subapically (Figs. 38D, 38E) 6
Sixth metasomal sternum more conspicuously constricted subapically (Figs. 38A, 38C) 7
6. Lateral surface of mesepisternum with posterior margin with conspicuous fascia of appressed, squamose setae; scuto-scutellar suture with dense fascia *soror*
Lateral surface of mesepisternum with posterior margin with fascia sparse, indistinct or formed from erect, slender setae; scuto-scutellar suture with fascia indistinct *mesae*
7. Mesepisternum with lateral surface contiguously punctured; axilla usually with small carinae defining dorsal surface (Fig. 37A); scutum closely punctured *edita*
Mesepisternum with lateral surface moderately punctured; axilla not carinate; scutum moderately to sparsely punctured *galactiae*

KEY TO MALES OF *Xerocoelioxys*

1. Sixth metasomal tergum with dorsal spines reduced, broad as in Figures 38H, 38I 2
Sixth metasomal tergum with dorsal spines at least as conspicuous as shown in Figure 38G 4
2. Hypostomal area of the gena with distinct excavation (as in Figs. 5-6); fore coxal spine conspicuous, without brown setae *soror*
Hypostomal area of the gena without distinct excavation; fore coxal spine reduced, with fascia of brown setae 3

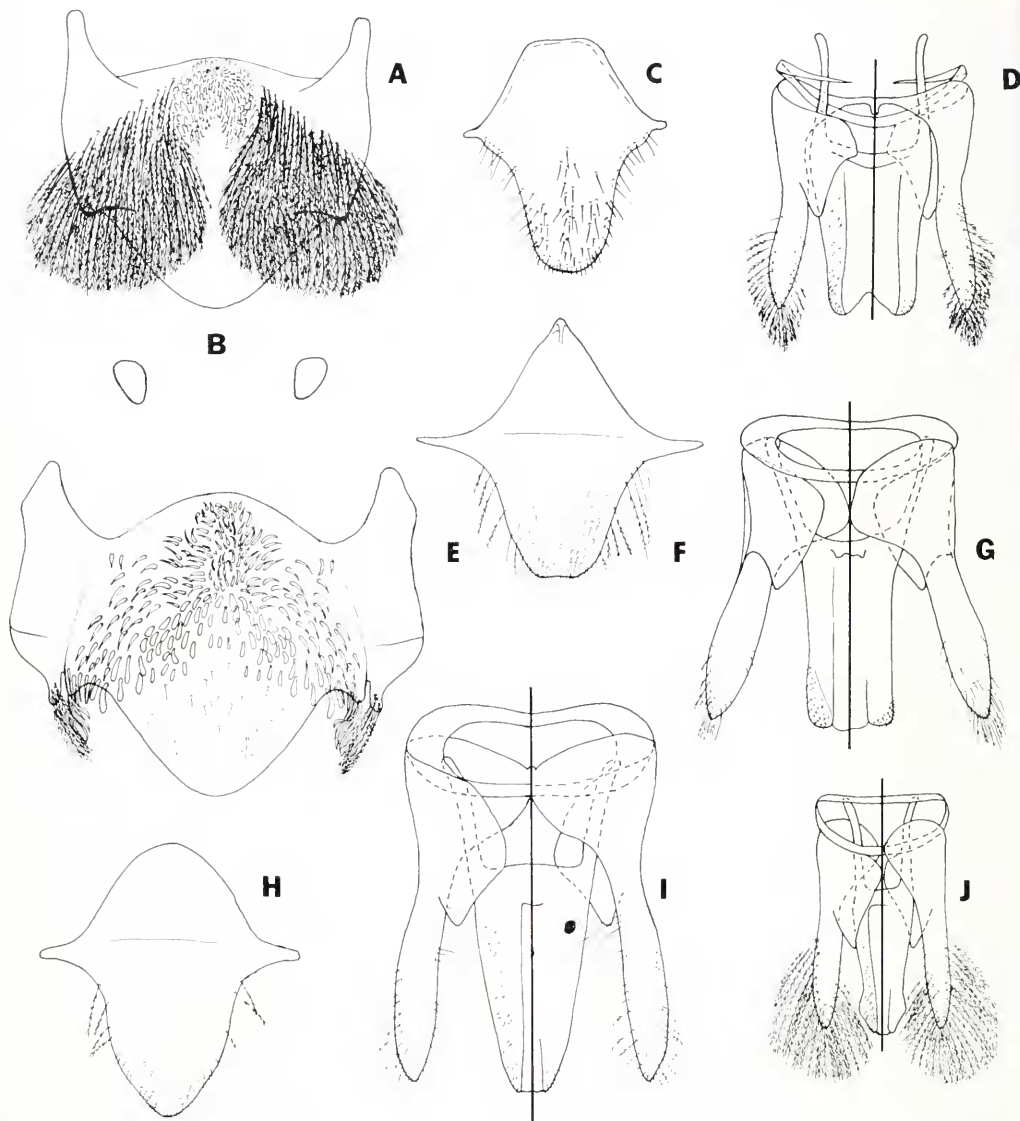


FIGURE 39. Hidden sclerites of males of *Xerocoelioxys*. A-D, *C. edita*. A, Sixth sternum; B, Seventh sternum (represented by two sclerites); C, Eighth sternum; D, Genital armature. E-G, *C. aperta*. E, Sixth sternum; F, Eighth sternum; G, Genital armature. H-I, *C. bicornuua*. H, Eighth sternum; I, Genital armature. J, *C. boharti*, genital armature.

3. Clypeal margin tridentate medially (Fig. 36B); legs, venter of metasoma usually black or piceous *aperta*
Clypeal margin bidentate medially (Fig. 36C); legs, venter of metasoma usually with ferruginous areas *bicornuua*
4. Lateral surface of mesepisternum almost covered by appressed, squamose (almost scale-like) setae; axilla without carina on

dorsal surface; ocellocipital distance at least subequal to ocellocular distance
..... *boharti*

- Lateral surface of mesepisternum without appressed squamose setae, or if with squamose setae then axilla with small carina (Fig. 37A) or ocellocipital distance less than ocellocular distance 5
5. Gena with dense fascia hiding surface;

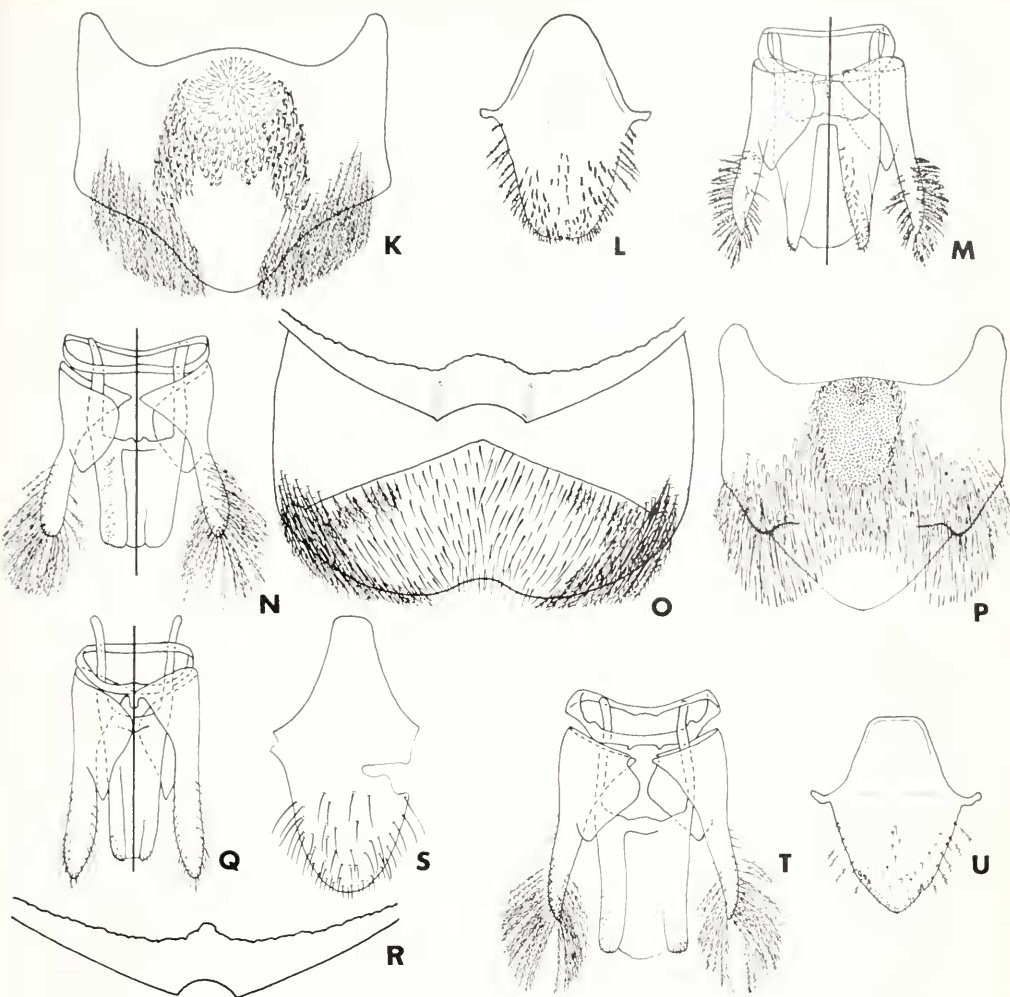


FIGURE 39. (continued) K-M, *C. mesae*. K, Sixth sternum; L, Eighth sternum; M, Genital armature. N, *C. galactiae*, genital armature. O-Q, *C. grindeliae*. O, apical margin of fourth sternum, fifth sternum; P, Sixth sternum; Q, Genital armature. R-T, *C. nodis*. R, margin of fourth sternum; S, Eighth sternum; T, Genital armature. U, *C. soledadensis*, eighth sternum.

- foveal area of metasomal tergum two with raised, impunctate area (Fig. 25H) *grindeliae*
 Gena usually with surface visible; foveal area of metasomal tergum two without raised impunctate area 6
 6. Lateral surface of mesepisternum with squamose setae; scutum with anterior fascia distinct, of squamose setae .. *edita*
 Lateral surface of mesepisternum with plumose but slender setae; scutum with anterior fascia variable, of plumose but slender setae 7
 7. Scutum moderately to sparsely punctured; ocular hairs short (about 0.06 mm) 8

Scutum closely punctured; ocular hairs medium length (about 0.09 mm)

..... *mesae*

8. Usually 10 mm or longer, midwestern distribution *nodis*
 Usually 10 mm or less; eastern distribution *galactiae*

Coelioxys edita Cresson

Figures 36A, 37A, 38A, G, 39 A-D, 40

Coelioxys edita Cresson, 1872, Trans. Amer. Entomol. Soc. 4:272 (♂, Texas, type # 2502 in the Academy of Natu-

ral Sciences of Philadelphia); Crawford, 1914, Ann. Entomol. Soc. Amer. 7:153 (? = *deplanata*); Hill, 1936, Entomol. News 47:207 (= *deplanata*).
Coelioxys deplanata Cresson, 1878, Trans. Amer. Entomol. Soc. 7:96 (♀, Kansas, Colorado, type # 2487 in the Academy of Natural Sciences of Philadelphia).

FEMALE. (1) Length 9.5-14 mm; (2) integument granular on vertex, very finely rugulose on thorax and metasoma, black; antenna black to piceous; coxae, trochanters, venter of metasoma piceous to ferruginous; legs piceous to ferruginous; basal metasomal terga black to ferruginous; (3) pubescence white, yellowish on clypeus, golden on tarsi; (4) ocular hairs short (about 0.03 mm); (5) clypeus with surface rounded horizontally, rugose, contiguously punctured, covered with very short setae; margin with two strong denticles (Fig. 36A) obscured by dense setal fringe; (6) clypeoantennal distance less than lateral margin of clypeus; (7) paraocular area hidden by appressed setae about 0.1 mm long; (8) rest of face coarsely, closely punctured, upper median area bare; (9) clypeoantennal distance greater than antennocular distance and less than interantennal distance; (10) ocellar area with impunctate areas slightly less conspicuous than shown in Figures 10, 11A; (11) interocellar distance greater than ocelloccipital distance and less than ocellocular distance; (12) vertex less closely punctured anteriorly and more closely punctured posteriorly than shown in Figure 10; (13) gena narrower than eye, strongly constricted ventrally, surface visible; ventral angle greater than 90°; (14) hypostomal area of gena with setae shorter than those on disc; (15) mandible with outer surface closely punctured (Fig. 36A); (16) scutum moderately punctured medially, closely punctured laterally; distinct anterior fascia interrupted medially; slender, suberect setae in every puncture on disc;

(17) lateral surface of mesepisternum contiguously punctured with large punctures, scattered squamose setae on disc; conspicuous fasciae anteriorly and posteriorly; (18) scutellum with posterior margin slightly emarginate in some specimens (Fig. 37A); (19) axilla with small carina defining dorsal surface (Fig. 37A); (20) metanotal setae prostrate medially; (21) fore coxal spine about 0.16 mm long, rounded apically, directed ventrally; (22) terga 2, 3 with conspicuous gradular grooves, terga 1-5 with conspicuous apical fasciae, tergum 1 with sparse basal fascia; punctures moderately (tergum 1) to closely punctured (tergum 6), tergum 2 with foveal area closely punctured; tergum 6 with subapical carina (Fig. 38A); (23) sterna 1-5 fasciate apically, fascia of sternum 1 interrupted submedially, fascia of sternum 5 incomplete medially; punctures on sterna 1-4, basally on 5, 6 moderately spaced; sterna 5, 6 apically very closely punctured; sternum 6 with margin constricted subapically (Fig. 38A).

MALE. (24) Length 8.5-10.5 mm; (25) integument as in female (2 above); (26) pubescence white, golden on tarsi; (27) ocular hairs short (about 0.05 mm); (28) clypeus hidden by copious setae about 0.3 mm long; surface rugulose and shiny; margin as in Figure 36A; (29) clypeoantennal distance as in female (6 above); (30) paraocular area hidden by setae about 0.3 mm long; (31) rest of face coarsely punctured, hidden by setae about 0.3 mm long; (32) interantennal distance subequal to clypeoantennal distance, greater than antennocular distance; (33) ocellar area as in female (10 above); (34) interocellar and ocelloccipital distances subequal, less than ocellocular distance; (35) vertex more closely punctured than shown in Figure 10; (36) gena narrowed ventrally; surface visible; ventral angle greater than 90°; (37) hypostomal area of gena modified into distinct excavation (Fig. 6); an-

terior, posterior portions with setae shorter than on disc of gena; (38-43) mandible, scutum, mesepisternum, scutellum, axilla, metanotal setae as in female (15-20 above); (44) front coxal spine conspicuous (0.3 mm long, 0.15 mm wide) with setae on dorsal and ventral surfaces, rounded apically, directed anteriorly; (45) terga 1-5 with distinct apical fasciae diminishing posteriorly, gradular grooves of terga 5, 6 with conspicuous fasciae; foveal area of tergum 2 closely punctured but not sunken; tergum 6 with dorsal spines stout (Fig. 38G); tergum 7 unmodified (as in Fig. 26A); (46) sterna 1-4 with punctures and fasciae as in female (23 above); (47) sternum 4 submarginally carinate (as in

Fig. 26C), fascia incomplete, apex entire; sternum 5 as in Figure 19C except margin with small, median emargination; sternum 6 with conspicuous shoulders (Fig. 39A); sternum 7 represented by two sclerites (Fig. 39B); sternum 8 with base broad (Fig. 39C); genital armature with gonobase incomplete, setae on gonocoxite sparse (Fig. 39D).

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys edita* ranges from southern Canada into northern Mexico (Fig. 40). Few specimens have been collected east of the Mississippi River.

This bee is in flight at least from April 10 (Texas) to October 11 (Baja California).

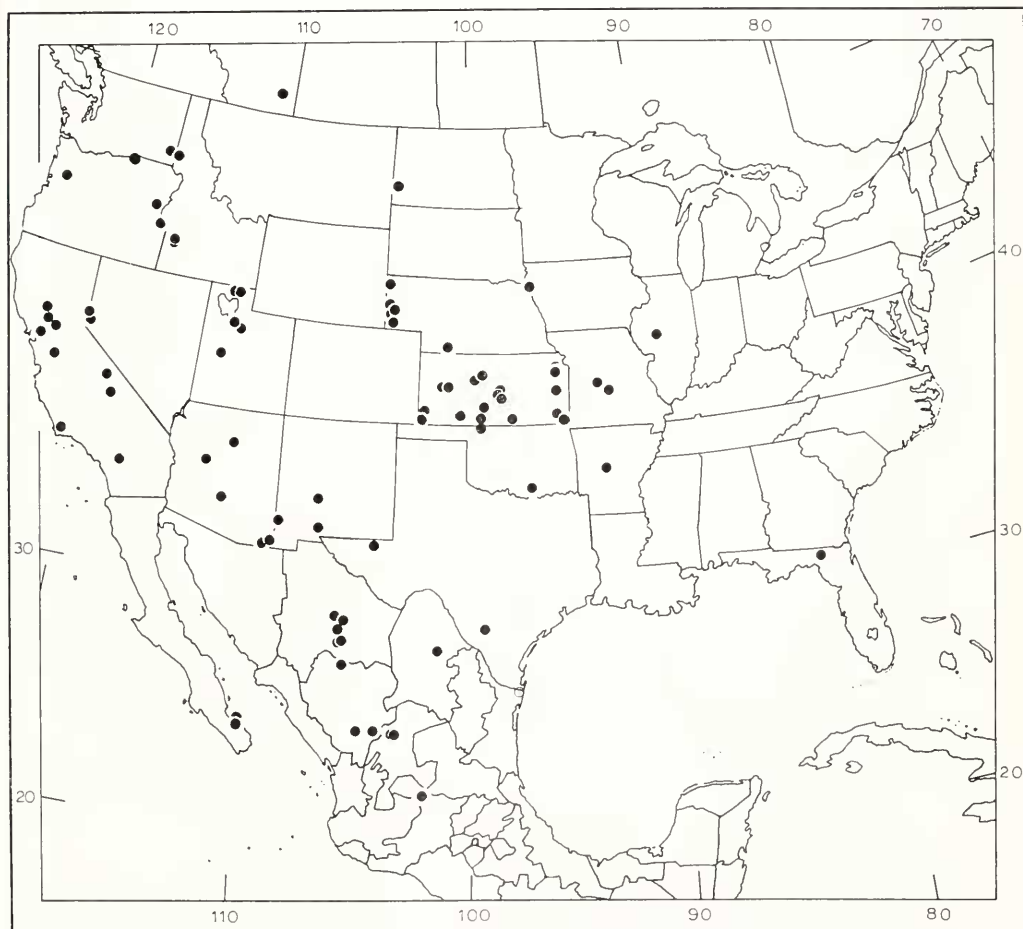


FIGURE 40. Distribution of *Coelioxys edita*.

HABITAT. *Coelioxys edita* has been collected from areas classified as a wide variety of vegetation types. Its distribution does not seem to be related to vegetation type.

COMPARATIVE COMMENTS. *Coelioxys edita* most closely resembles *C. bisoncornua* from which it can be distinguished by the slightly carinate axilla and slightly emarginate scutellum (non-carinate axilla and slightly produced scutellum in *C. bisoncornua*, compare Figs. 37A and 37E).

Coelioxys aperta Cresson

Figures 36B, 37B, 38H, 39E-G, 41

Coelioxys aperta Cresson, 1878, Trans. Amer. Entomol. Soc. 7:95 (♀, Colorado, type # 2488 in the Academy of Natural Sciences of Philadelphia); Cockerell, 1921, Amer. Mus. Novitates 21:4-10 (♂ described, key).

FEMALE. Agrees with description and figures of *Coelioxys edita* except as follows: (1) Length 11-15.5 mm; (2) integument black; antenna, tegula, piceous; legs piceous to dark ferruginous; (4) ocular hairs short (about 0.05 mm); (5) clypeus slightly convex to rounded horizontally, rugose, shining; surface visible except for longitudinal median line covered with short, appressed setae, lateral and dorsal margins bare; margin with three strong denticles (Fig. 36B); setal fringe scant; (7) paraocular area visible between setae about 0.3 mm long; (8) rest of face closely, coarsely punctured except for irregular mediosagittal line; (10) ocellar area closely punctured; (11) interocellar and ocellocipital distances subequal, less than ocellocular distance; (12) vertex closely punctured; (14) hypostomal area of gena with setae longer than those on disc; (15) mandible with outer surface rounder than shown in Figure 36A (Fig. 36B); (16) scutum closely punctured, longitudinal median line complete; anterior fascia represented by median patch, weaker lateral

line; (17) mesepisternum with anterior and posterior fasciae sparse; (18) scutellum with posterior margin produced slightly (Fig. 37B); (19) axilla without carina (Fig. 37B); (21) front coxal spine reduced; (22) tergum with foveal area unmodified; (23) fascia of sternum 1 represented by median patch, fascia of sternum 5 complete.

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 9.5-12.5 mm; (25) integument as in female (2 above); (27) ocular hairs of medium length (about 0.1 mm); (28) clypeus obscured by long setae (about 0.45 mm); (30) paraocular area obscured by setae about 0.45 mm long; (32) clypeoantennal distance less than interantennal distance, greater than antennoocular distance; (33) ocellar area as in female (10 above); (34) ocellocular distance greater than interocellar distance, less than ocellocipital distance; (36) gena with ventral angle less than 90°; (37) hypostomal area of gena *not* excavated, but as in female (14 above); (38-43) mandible, scutum, mesepisternum, scutellum, axilla, metanotal setae as in female (15-20 above); (44) front coxal spine reduced, with dense, brown anteroventrally directed spot of setae; (45) terga 3-5 with apical fasciae incomplete medially, median fasciae becoming more distinct posteriorly; tergum 2 with foveal area unmodified; tergum 6 with dorsal spines reduced (Fig. 38H); tergum 7 with apical spine about half as long as shown in Figure 13A; (46) sterna 1-4 with punctures and fasciae as in female (23 above) except each puncture with seta becoming more conspicuous posteriorly; gradular grooves with fasciae; (47) sternum 4 subapically carinate, fascia complete; emargination of sternum 5 broad; shoulders of sternum 6 bifid, setae inflated medioposteriorly (Fig. 39E); sternum 8 with lateral angles extended,

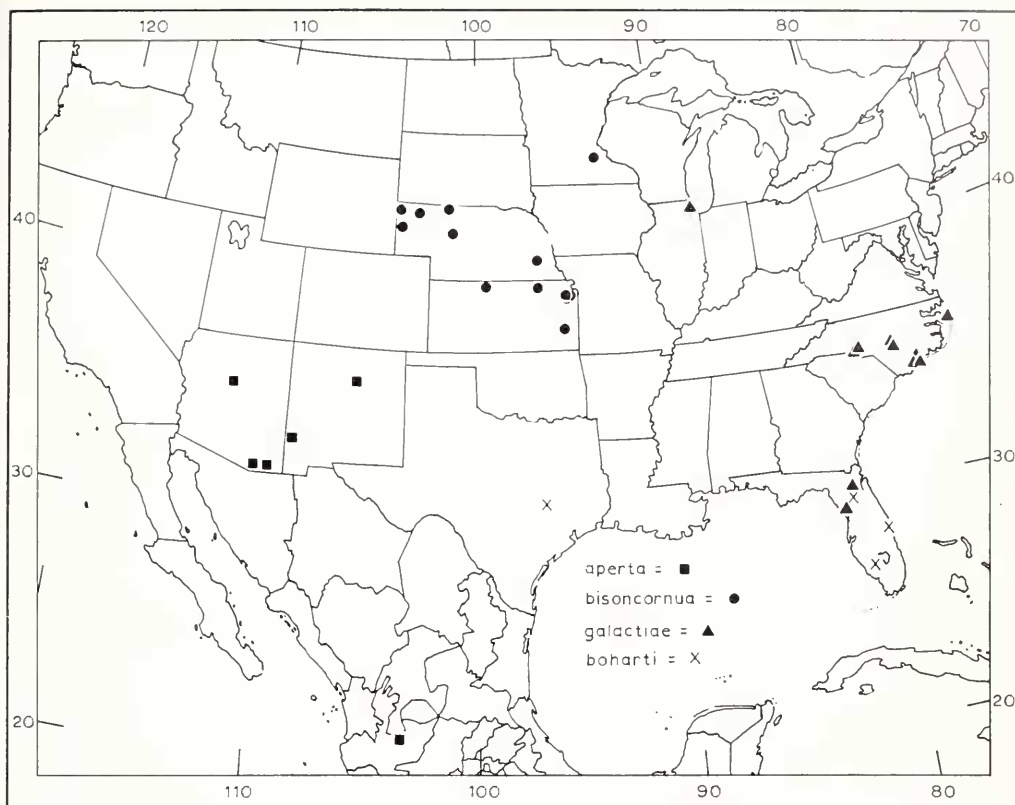


FIGURE 41. Distributions of *Coelioxys aperta*, *C. bisoncornua*, *C. boharti*, and *C. galactiae*. *Coelioxys aperta* is also known from Colorado (state record only).

base narrow (Fig. 39F); genital armature with slender branched setae on gonocoxites (Fig. 39G).

DISTRIBUTION AND SEASON OF FLIGHT. This bee ranges from Colorado to Guadalajara, Mexico (Fig. 41).

Coelioxys aperta is in flight at least from July 19 (New Mexico) to October 5 (Arizona) and to October 16 (Guadalajara, Mexico).

HABITAT. Areas classified as western coniferous forests (*Abies*, *Picea*, *Pinus*, *Pseudotsuga*) appear to be the principal habitat of *Coelioxys aperta* although it has been collected in oak-juniper woodland (*Quercus*, *Juniperus*) and perhaps has been collected in grama-tobosa shrubsteppe (*Bouteloua*, *Hilaria*, *Larrea*).

GEOGRAPHIC VARIATION. Al-

though the series of this species is small, specimens from the southern part of the range are larger with the clypeal marginal denticles longer and the metasomal fascial more distinct.

COMPARATIVE COMMENTS.

Coelioxys aperta resembles the larger, darker specimens of *C. edita* but differs in both sexes by the conspicuous median tooth of the clypeal margin (Fig. 36B), the small median projection of the scutellum (Fig. 37B), and the lack of carinae on the axillae (Fig. 37B). The reduced fore coxal spines of both sexes, the spine on tergum seven of males, the bifid shoulders of sternum six in males, the wide eighth sternum, and the complete gonobase of the genital armature are different from other bees in *Xerocoelioxys* except for *C. bisoncornua*. The lack of an exca-

vation of the hypostomal area of the gena suggests males of *Synocoelioxys* (Fig. 3).

Coelioxys bisoncornua Hill

Figures 36C, 37E, 38B, 39H-I, 41

Coelioxys bisoncornua Hill, 1936, Entomol. News 47:205 (♀, ♂, Nebraska, Kansas, type in the collection of The University of Nebraska, Lincoln).

FEMALE. Agrees with description and figures of *Coelioxys edita* except as follows: (1) Length 12-15 mm; (2) integument black, antenna black to ferruginous; mandibles rufous; legs, venter of metasomal rufous to ferruginous; tegula brown; (4) ocular hairs very short (about 0.16 mm); (5) clypeus slightly convex; bare or visible through short (about 0.15 mm) appressed setae; margin with sparse fringe, two strong denticles (Fig. 36C); (7) paraocular area with ventral half bare or with scattered appressed setae; (8) rest of face bare except for area about 0.3 mm wide around base of antenna; (10) ocellar area closely punctate; (11) ocellocular distance subequal to ocellocipital distance, greater than interocellar distance; (12) vertex very closely punctured laterally, contiguously punctured with slightly smaller punctures medially; (13) gena constricted ventrally; (15) mandible with flange on outer surface (Fig. 36C); (16) scutum with indistinct anterior fascia complete; slender, erect setae on disc sparse, short; (17) lateral surface of mesepisternum contiguously punctured with medium sized punctures, fascia indistinct; (18) scutellum with posterior margin rounded, produced medially (Fig. 37E); (19) axilla without carinae (Fig. 37E); (20) metanotum with dorsal setae subprostrate; (21) front coxal spine reduced; (22) tergum 3 with gradular groove shallow or incomplete medially; terga 1, 5 closely punctured, tergum 6 very closely punctured, terga 2-4 moderately punctured; foveal area of tergum 2 unmodified; ter-

gum 6 broadly rounded (Fig. 38B); (23) sterna 1-5 sparsely fasciate apically, fascia of sternum 1 a median patch; sterna 1-5 moderately punctured, sternum 6 with contiguous, elongate, irregular punctures, subapically notched in some specimens (Fig. 38B).

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 11-14.5 mm; (25) integument as in female (2 above); (28) clypeus obscured by long (about 0.45 mm) copious setae; (30) paraocular area obscured by setae about 0.45 mm long; (31) rest of face obscured by setae about 0.45 mm long; (32) clypeoantennal distance greater than antennocular distance, less than interantennal distance; (33) ocellar area as in female (10 above); (34) ocellocipital distance less than ocellocipital distance, greater than interocellar distance; (37) hypostomal area of gena *not* excavated, but as in female (14 above); (38) mandible with outer margin slightly rounder than shown in Figure 36B; (39-43) scutum, mesepisternum, scutellum, axilla, metanotal setae as in female (16-20 above); (44) front coxal spine as described for male of *C. aperta*; (45) foveal area of tergum 2 unmodified; tergum 6 as in Figure 38H; tergum 7 as described for *C. aperta*; (46) sterna 1-4 with conspicuous apical fasciae, 2-4 with conspicuous basal fasciae in gradular grooves; (47) margin of sternum 4 broadly emarginate; margin of sternum 5 entire, sternum 6 as in Figure 39E but with slightly more copious setae; sternum 8 broadly rounded basally (Fig. 39H); genital armature large (Fig. 39I).

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys bisoncornua* ranges from Minnesota through Nebraska and Kansas (Fig. 41).

This bee is in flight at least from July 28 to September 13.

HABITAT. *Coelioxys bisoncornua* has

been taken in areas classified mostly as central and eastern grasslands, grassland and forest combinations but also in eastern ponderosa pine forest, northern flood plain forest and oak-hickory forest.

Flower records indicate an open, disturbed habitat as all but one are sunflower, a flower of open areas rather than woodlands. Furthermore, Mr. K. W. Richards captured a female "searching" along a dirt bank near Lawrence, Kansas.

COMPARATIVE COMMENTS. This bee is most likely to be confused with large specimens of *Coelioxys edita* because *C. edita* is far more common than the more similar *C. aperta*. Females of *C. bisoncornua* have a conspicuous flange on the outer surface of the mandible (Fig. 36C) which is lacking in *C. edita* and *C. aperta*. Males of *C. bisoncornua* lack small carinae on the axillae evident in *C. edita* (compare Figs. 37A and 37E) and have more ferruginous areas on the legs and venter of the metasoma than the darker *C. aperta*.

Coelioxys boharti Mitchell
Figures 39J, 41

Coelioxys boharti Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:194, 206-207 (♂, Florida, type in the collection of the National Museum of Natural History).

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 12-13.5 mm; (25) integument black; antenna, tegula, legs piceous; venter of metasoma dark ferruginous; (26) pubescence white, slightly yellow on face, golden on tarsi; (31) rest of face hidden ventrally by appressed setae about 0.15 mm long, dorsally by subappressed setae about 0.45 mm long; (32) clypeoantennal distance greater than antennocular distance, less than interantennal distance; (33) ocellar area moderately punctured; (34) ocellocular distance less

than ocellocipital distance, greater than interocellar distance; (37) excavation of hypostomal area of gena almost bare; (38) mandible with outer surface rounded as in Figure 67E; (39) scutum with anterior fascia sparse medially; (40) mesepisternum with lateral surface closely punctured with large punctures; punctures filled with appressed, squamose setae which may hide the surface; (42) axilla not carinate; (45) foveal area of tergum 2 closely punctured with small punctures, very slightly sunken; tergum 6 with dorsal spines as in Figure 38G; (47) apical margin of sternum 4, sternum 5 as in Figure 26B; sternum 8 as in Figure 26E; genital armature with gonobase entire, setae on gonocoxite long (Fig. 39J).

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys boharti* has been collected in Texas (College Station) and Florida (Alachua County, Cocoa, and Labelle, Fig. 41).

This bee is in flight at least from June 21 to August 17.

HABITAT. This bee, known only from the male, has been taken from areas classified as oak-hickory (*Quercus-Carya*), southern mixed forest (*Fagus, Liquidambar, Magnolia, Pinus, Quercus*), and palmetto prairie (*Serenoa-Aristida*).

COMPARATIVE COMMENTS. *Coelioxys boharti* resembles males of *C. galactiae* but is larger. The lateral surface of the mesepisternum is almost hidden by appressed squamose setae in *C. boharti* but is almost bare with scattered, erect, plumose (but slender) setae in *C. galactiae*.

Coelioxys galactiae Mitchell
Figures 38C, 39N, 41

Coelioxys galactiae Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:193-195, 204-206 (♀, ♂ North Carolina, Florida, Illinois, type is collection of T. B. Mitchell).

FEMALE. Agrees with description and figures of *Coelioxys edita* except as follows: (1) Length 9-11 mm; (2) integument granular on vertex, thorax; finely rugulose on metasoma; black; antenna, tegula piceous; mandible, venter and dorsum (basally) of metasoma black to rufous; legs rufous to ferruginous; (3) pubescence white, yellowish on face, golden on tarsi; (4) ocular hairs short (about 0.06 mm); (5) clypeus almost flat, margin with 4-6 denticles obscured by apical fringe; (10) ocellar area moderately punctate anteriorly; (11) interocellar distance slightly greater than ocellocipital distance, less than ocellocular distance; (12) vertex punctured as in Figure 10; (13) gena constricted ventrally; surface almost obscured; (15) mandible as in Figure 22E; (16) scutum punctured as vertex in Figure 10; anterior fascia indistinct; (17) lateral margin of mesepisternum moderately punctured, fasciae distinct; (18) scutellum sparsely punctured; (19) axilla without conspicuous carinae; (22) tergum 1 with basal fascia inconspicuous; postgradular areas less closely punctate than pregradular areas; tergum 6 narrowly rounded apically (Fig. 38C); (23) fascia of sternum 5 sparse but complete medially; apical portion of sternum 6 longer than shown in Figure 38A (Fig. 38C).

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 9-10 mm; (25) integument as in female (2 above); (26) pubescence white, yellow on face, golden on tarsi; (32) clypeoantennal distance greater than antennocular distance, less than interantennal distance; (33) ocellar area as in female (10 above); (34) ocellocipital distance greater than interocellar distance, greater than ocellocular distance; (38) mandible as in female (15 above); (39) scutum moderately punctured; (40) mesepisternum moderately punctured, almost

obscured by setae about 0.45 mm long; (41, 42) scutellum, axilla as in female (18-19 above); (45) gradular groove of tergum 4 with conspicuous fasciae laterally; tergum 6 with apical spines slightly more elongate than shown in Figure 39G; (47) sternum 4 with subapical carina indented medially, apical margin bidentate as in Figure 39O; sternum 6 as in Figure 39A; sternum 8 with base about half as broad as shown in Figure 39C; abundant setae apically on gonocoxite (Fig. 39N).

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys galactiae* is confined to the eastern United States (Fig. 41).

This bee is in flight at least from June 23 to August 6.

HABITAT. *Coelioxys galactiae* has been collected from areas classified as a mixture of bluestem prairie and oak-hickory forest (*Andropogon*, *Panicum*, *Sorghastrum*, *Quercus*, *Carya*), oak-hickory forest, oak-hickory-pine forest (*Pinus*), southern mixed forest (*Fagus*, *Liquidambar*, *Magnolia*, *Pinus*, *Quercus*), and pocosin (*Pinus*, *Ilex*).

COMPARATIVE COMMENTS. This bee is similar to *Coelioxys edita* but differs by the more attenuate sixth sternum of females (compare Figs. 38C and 38A) and more attenuate apical spines of males (longer than shown in Fig. 38G). Also the axillae of *C. galactiae* in both sexes are not carinate and are more sparsely punctured than those of *C. edita* (Fig. 37A).

Coelioxys grindeliae Cockerell

Figures 25H, 37C, 38E, 39O-Q; 44

Coelioxys grindeliae Cockerell, 1900, Can. Entomol. 32:297-301 (♂, ♀ New Mexico, key, type in the American Museum of Natural History);

Coelioxys grindeliae denverensis Cockerell, 1912, Can. Entomol. 44:166-170 (♂, Colorado, key, type in the National Museum of Natural History);

Coelioxys lamellicauda Cockerell, 1921, Amer. Mus. Novitates 21:6-8 (♂, Colorado, type in the American Museum of Natural History).

FEMALE. Agrees with description and figures of *Coelioxys edita* except as follows: (1) Length 9-11.5 mm; (2) integument black; antenna, legs, tegula, venter of metasoma black to piceous; (3) pubescence white, golden on tarsi; (5) clypeus almost flat, very closely punctate, almost hidden by dense, 1.5 mm long, plumose setae and scattered erect setae; margin with 5 small evenly spaced denticles; (7) paraocular area hidden by dense, plumose setae 2.0 mm long; (8) rest of face closely punctured except for longitudinal median line, almost hidden by appressed, plumose setae; (10) ocellar area moderately to closely punctured; (12) vertex punctured as in Figure 21; (13) gena constricted ventrally, surface visible anteriorly; (15) mandible as in Figure 22E; (16) scutum closely punctured; anterior fascia sparse medially; (17) lateral surface of mesepisternum nearly to completely contiguously punctured, disc bare or with scattered, suberect setae; (18) scutellum sometimes with longitudinal median impunctate ridge (Fig. 37C); (19) axilla long (Fig. 37C); (22) tergum 1 with basal fascia inconspicuous; tergum 2 with foveal area unmodified; tergum 6 more slender than shown in Figure 38A (Fig. 38E); (23) sterna 1-5 moderately to sparsely punctured, punctures very shallow medially, surface shining; sternum 5 apically contiguously punctured with small punctures; sternum 6 elongate apically (Fig. 38E).

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 9.5-11 mm; (25) integument as in female (2 above); (28) clypeal margin with 3 distinct denticles; (33) ocellar area as in female (10 above); (36) ventral half of gena hidden by dense

setal fascia; (38, 39) mandible, scutum as in female (15, 16 above); (40) mesepisternum with lateral surface almost hidden in some specimens; (41-43) scutellum, axilla, metanotal setae as in female (18-20 above); (45) foveal areas of tergum 2 with small, raised, impunctate area (Fig. 25H); (46) sterna 1-4 with conspicuous fasciae posteriorly; sternum 4 carinate subapically, margin with 2 projections (Fig. 39O); sternum 6 with mostly expanded, rather than plumose setae, heavily pigmented laterally (Fig. 39P); sternum 8 with base broadly rounded; genital armature with gonobase complete (Fig. 39Q).

HOST RECORDS. Hicks (1926) reported *Coelioxys grindeliae* to be a parasite of *Megachile perihirta*.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys grindeliae* is confined to southern Canada and the western United States (Fig. 44).

This bee is in flight at least from June 4 (northern California) to September 26 (Middle California).

HABITAT. *Coelioxys grindeliae* has been taken from a diversity of western forest, shrub and grassland vegetation types, as well as central and eastern grassland vegetation types and northern floodplain forest.

COMPARATIVE COMMENTS. Most specimens of *Coelioxys grindeliae* have the gena obscured by a dense, white fascia, a condition found in no other species in this group. Males of *C. grindeliae* are distinguished from other males by the raised, impunctate area of the foveal area (Fig. 25H). Females are distinguished by the elongate sixth metasomal sternum (Fig. 38E), dark legs, and sometimes by the raised longitudinal median line of the scutellum (Fig. 37C).

Coelioxys mesae Cockerell

Figures 39K-M, 42A, 43

Coelioxys mesae Cockerell, 1921, Amer.

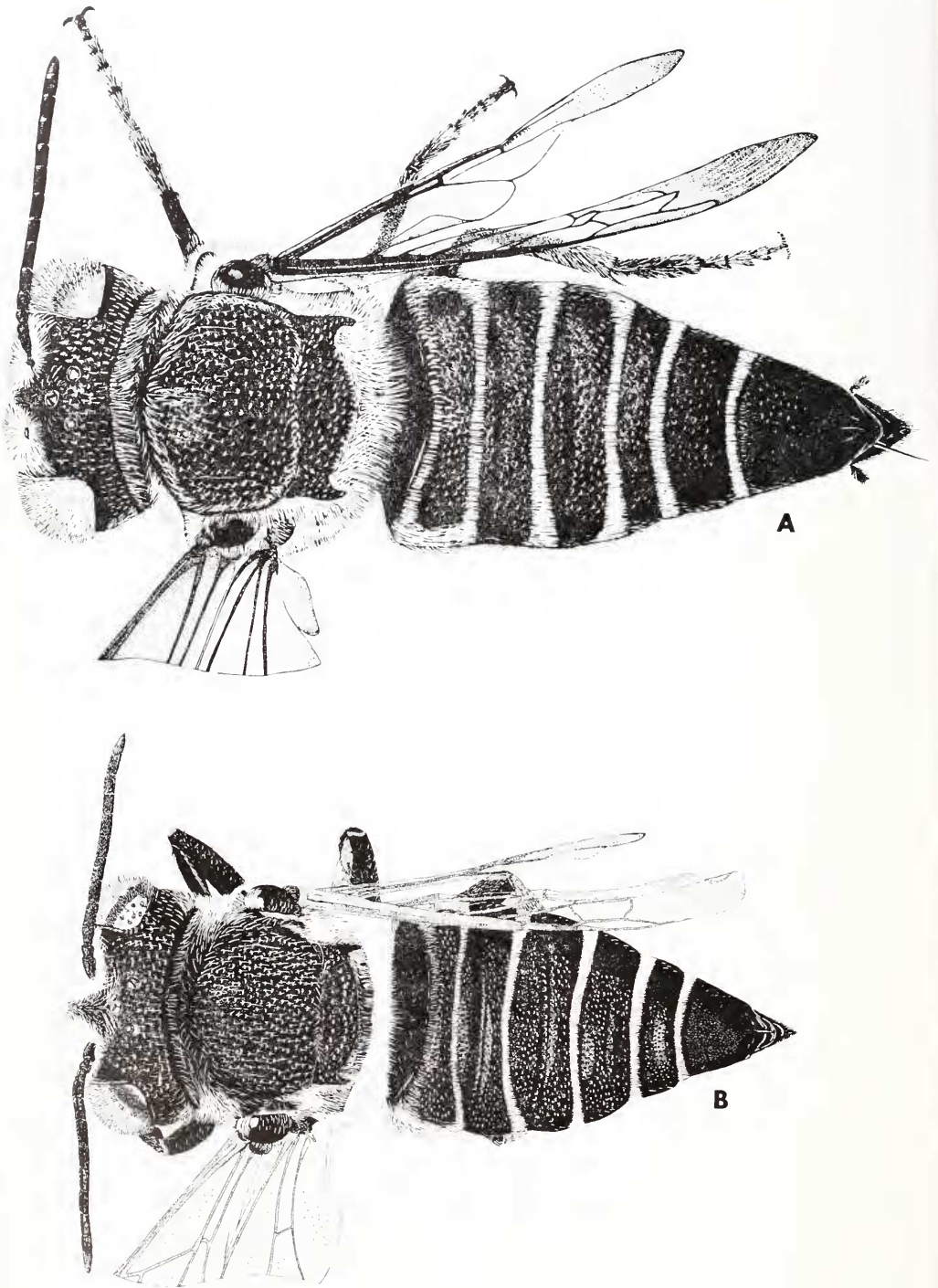


FIGURE 42. Dorsal views of female *Coelioxys*. A, *C. mesae*; B, *C. mitchelli*.

Mus. Novitates 21:6 (♂, Colorado, type in the American Museum of Natural History).

FEMALE. Agrees with description and figures of *Coelioxys edita* except as follows: (2) Integument finely granular, dull on vertex, metasoma; black; antenna, legs, venter of metasoma black to piceous; (3) pubescence white, sometimes brownish on mesosoma, golden on tarsi; (4) ocular hairs medium length (0.08 mm); (5) clypeus convex, rugose, closely punctured, shiny; disc bare, margin with 5 small denticles; apical fringe conspicuous but not dense; (7) paraocular area hidden by setae up to 0.3 mm long; (8) ventral portion of face with sparse, appressed setae about 0.1 mm long; dorsal portion with mediosagittal portion bare or obscured by longer setae; (10) ocellar area closely punctured; (12) vertex coarsely, evenly punctured (Fig. 42A); (13) gena with ventral angle about 90°; (15) mandible with outer margin rounded as in Figure 22E; (16) scutum closely, evenly punctured; disc with short, inconspicuous erect setae (Fig. 42A); (17) lateral surface of mesepisternum largely bare, fasciae sometimes indistinct; (18) scutellum with posterior margin almost straight medially (Fig. 42A); (19) axilla not carinate (Fig. 42A); (21) front coxal spine directed anteriorly; (22) metasomal terga closely punctured; tergum 2 with foveal area unmodified; tergum 6 subtriangular (Fig. 42A); (23) sternum 5 complete medially; sternum 6 subtriangular apically (Fig. 42A).

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 9-11 mm; (25) integument as in female (2 above); (27) ocular hairs medium (about 0.1 mm); (28) clypeus hidden by copious setae about 0.36 mm long; margin as in female; (30) paraocular area hidden by setae about 0.45 mm long; (31) rest of face closely punctured;

hidden by setae about 0.4 mm long; (32) clypeoantennal distance less than interantennal distance, greater than antennoocular distance; (33) ocellar area as in female (10 above); (34) interocellar distance greater than ocellocapital distance, less than ocellocular distance; (35) vertex slightly more irregularly punctured than shown in Figure 42A; (36) gena slightly narrowed ventrally; (38, 39) mandible, scutum as in female (15, 16 above); (40) mesepisternum with slender, plumose setae on disc; (41-43) scutellum, axilla, metanotal setae as in female (18-20 above); (45) tergum 6 with dorsal spines more conspicuous than shown in Figure 38G; (47) sterna 4, 5 as in Figure 39O except for longitudinal ridges on rim of sternum 4; sternum 6 as in Figure 39K; sternum 8 with base rounded (Fig. 39L); gonocoxite with abundant, plumose setae (Fig. 39M).

HOST RECORDS. Dr. G. E. Bohart has reared this bee from a nest of *Megachile umatillensis* at Cornish, Utah.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys mesae* is confined to the western half of the United States (Fig. 43).

This bee is in flight at least from May 15 (Texas) and June 10 (Oregon) to August 29 (Utah).

HABITAT. Most localities from which *Coelioxys mesae* has been collected are classified as sagebrush steppe (*Artemisia-Agropyron*). Two specimens were collected from areas classified as grama-tobosa prairie (*Bouteloua, Hiluria*) and pine-Douglas fir forest (*Pinus, Pseudotsuga*).

COMPARATIVE COMMENTS. Females of *Coelioxys mesae* differ from those of *C. edita* by darker integument and entire lateral margin of the sixth sternum (compare Figs. 42A and 38A) and from those of *C. mitchelli* by the greater amount of appressed, squamose setae on

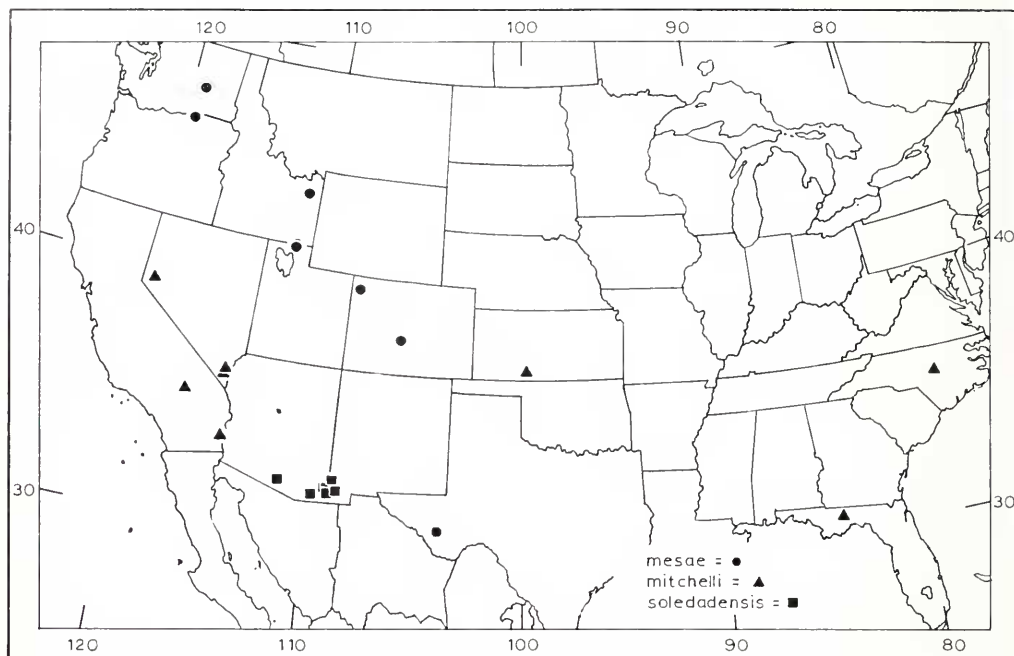


FIGURE 43. Distributions of *Coelioxys mesae*, *C. mitchelli*, and *C. soledadensis*.

the scutum, scutellum, and metanotum (compare Figs. 42A and B). Males of *C. mesae* differ from those of *C. edita* by longer ocular hairs, longer facial setae, and darker integument. Males of *C. mesae* differ from those of *C. mitchelli* by the entire, distinct basal fascia of tergum one (incomplete in *C. mitchelli*).

Coelioxys nodis, new species

Figures 38J, 39R-T, 48

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 10-11 mm; (25) integument black, antenna, dorsum of metasoma black to piceous; legs, tegula, venter of metasoma piceous to ferruginous; (28) margin of clypeus with six small denticles; (30) paraocular area hidden by setae about 0.45 mm long; (31) rest of face hidden by appressed setae about 0.25 mm long; (33) ocellar area with small, irregular impunctate areas anteriorly; (34) ocellocipital distance greater than interocellar distance, less than ocellocular distance; (38) man-

dible with outer surface simple as in Figure 22E; (39) scutum moderately punctured, anterior fascia indistinct; (40) lateral surface of mesepisternum closely punctured, setae squamose to slender, fascia indistinct; (41) scutellum slightly rounded posteriorly, sparsely punctured; (42) axilla without carinae; (45) tergum 6 with dorsal spines reduced, broad (Fig. 38J); (47) sternum 4 with submarginal carina indented medially (Fig. 39R); sternum 8 with base truncate (Fig. 39S); genital armature with gonobase lobed, gonocoxite with long, abundant setae (Fig. 39T).

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys nodis* has been collected in Illinois, Kansas, and Nebraska (Fig. 48) from July 3-12.

HABITAT. *Coelioxys nodis* has been collected in bluestem grama prairie (*Andropogon*, *Bouteloua*).

COMPARATIVE COMMENTS. *Coelioxys nodis* resembles larger males of *C. edita* but differs by lack of carinae on

FIGURE 44. Distribution of *Coelioxys grindeliae*.

the axillae, by the subapical carina of sternum four which is indented medially (Fig. 39R), and by the dorsal spines of tergum six which are broad (compare Figs. 38J and 38G).

TYPES. Holotype male, Carns, Nebraska, July 3, 1902, *Verbena* (W. D. Pierce), in the collection of the University of Nebraska at Lincoln. Paratypes males; one, Sioux Co., Nebraska; one, Trego Co., Kansas, 2450 feet, July 12, 1912 (F. X. Williams); one, 35530, Sands, Illinois (Hart), 128. Paratypes in the collections of the University of Nebraska and the University of Kansas.

The specific names refer to the lobes on the gonobase which are more conspicuous in this species than any other in this study.

Coelioxys piercei Crawford
Figure 38F

Coelioxys piercei Crawford, 1914, Ann. Entomol. Soc. Amer. 7:152-153 (♀, Texas, type # 18219 in the National Natural History Museum).

FEMALE. Agrees with description and figures of *Coelioxys edita* except as follows: (1) Length 9.5 mm; (2) in-

tegument black; antenna, legs, tegula piceous; (4) ocular hairs short (about 0.05 mm long); (5) clypeus with surface almost convex, clypeal margin with 3 small denticles; (10) ocellar area closely punctate; (12) vertex moderately punctured; (15) mandible with outer margin rounded, resembling that shown in Figure 22E; (16) scutum moderately punctured, fascia slightly more conspicuous laterally than anteriorly; (17) lateral surface of mesepisternum dorsally with slender, scattered setae on disc; (18) scutellum with posterior margin as in Figure 42B; punctures as in Figure 37D; (19) axilla elongate as in Figure 37B; (22) tergum 2 with foveal area unmodified; tergum 6 with subapical flattened projections (Fig. 38F); sterna 1-5 fasciate apically; sternum 6 with lateral margin entire (Fig. 38F).

DISTRIBUTION AND SEASON OF FLIGHT. Type specimen from Cotulla, Texas, taken on April 17. No other specimens are known.

HABITAT. The area surrounding Cotulla has been classified as mesquite-acacia savana (*Prosopis*, *Acacia*, *Andropogon*, *Setaria*).

COMPARATIVE COMMENTS. *Coelioxys piercei* resembles the females of *C. mesae* and *C. mitchelli* but differs by the flattened lateral projections of tergum six (Fig. 38F).

Coelioxys soledadensis Cockerell

Figures 37D; 38D, I; 39U; 43

Coelioxys soledadensis Cockerell, 1909, Entomol. News 20:9 (♂, New Mexico, type in the American Museum of Natural History).

FEMALE. Agrees with description and figures of *Coelioxys edita* except as follows: (1) Length 8-12 mm; (2) integument shiny on vertex; black, antenna, tegula black to piceous; legs, metasoma basally and ventrally piceous to rufous; (3) pubescence white, yellowish dorsally,

golden on tarsi; (5) clypeus slightly convex, visible through minute setae, margin with two denticles not as conspicuous as shown in Figure 36A; (7) paraocular area hidden by appressed setae about 0.05 mm; (8) lower portion of rest of face plus longitudinal median line up to ocellar area visible, closely punctured; (9) clypeo-antennal distance subequal to antennocular distance, less than interocellar distance; (10) ocellar area moderately punctured; (12) vertex moderately punctured; (14) hypostomal area of gena with setae subequal in length to those on disc; (15) mandible with outer surface rounded as in Figure 22E; (16) scutum evenly, contiguously punctured; anterior fascia distinct, narrowly interrupted medially; disc with minute suberect setae in each puncture; (17) lateral surface of mesepisternum moderately punctured, disc bare, fasciae distinct; (18) scutum with posterior margin rounded (Fig. 37D); (19) axilla not carinate (Fig. 37D); (22) terga 1, 2 very closely punctured; terga 3-5 moderately punctured; tergum 6 very closely, minutely punctured (Fig. 38D); (23) sternum 6 slightly constricted subapically (Fig. 38D).

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 8-10 mm; (25) integument black; antenna, legs, tegula, venter of metasoma black to rufous; (27) ocular hairs medium length (about 0.8 mm); (28) clypeal margin as in female (5 above); (31) rest of face closely punctured, rugulose; (32) clypeoantennal distance greater than antennocular distance, less than interantennal distance; (33) ocellar area as in female (10 above); (34) interocellar distance greater than ocellocipital distance, less than ocellocular distance; (35) vertex as in female (12 above); (37) hypostomal area of gena covered with small erect setae through which surface is visible, anteroventral portion of excava-

tion with setae longer than those on disc; (38-43) mandible, scutum, mesepisternum, scutellum, axilla, metanotal setae as in female (15-20 above); (45) terga 3-6 with gradular grooves conspicuous, tergum 6 with dorsal spines reduced (Fig. 38I); (47) sterna 4, 5 as in Figure 39O; sternum 6 much like Figure 19C, shoulders slightly more distinct; sternum 8 with base broad, apex narrowly rounded (Fig. 39U); gonocoxite with dense setae, gonobase complete, much like Figure 39J.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys soledadensis* has been collected in southern Arizona and New Mexico (Fig. 43).

This bee is in flight at least from July 5 to October 7.

HABITAT. *Coelioxys soledadensis* has been collected in areas classified as Arizona pine forest (*Pinus*), oak-juniper woodland (*Quercus*, *Juniperus*), creosote bush-bur sage (*Larrea*, *Franseria*), and grama-tobosa shrubsteppe (*Bouteloua*, *Hilaria*, *Larrea*).

COMPARATIVE COMMENTS. *Coelioxys soledadensis* most closely resembles *C. edita* from which it differs by the shiny vertex, moderately punctured lateral surface of the mesepisternum, slightly constricted sixth sternum of the female (compare Figs. 38A and 38D), and reduced dorsal spines of the sixth tergum of the male (compare Figs. 38I and 38G).

Subgenus *Coelioxys* Latreille

Coelioxys Latreille, 1809. Genera crustaceorum et insectorum secundum ordinem naturalem in familias disposita . . . 4: 166.

Type species: *Coelioxys quadridentata* Linnaeus.

The subgenus *Coelioxys* contains *C. hirsutissima*, *C. immaculata*, *C. mitchelli*, and *C. serricaudata*. This subgenus differs from *Xerocoelioxys* mainly in the reduced carina of the prothoracic tubercle.

Three hosts, all in different subgenera of *Megachile*, have been reported for *Coelioxys*

sodalis (Table 1). Hosts have not been discovered for the remaining species in this group.

Most of the characters listed below are found in other groups of New World *Coelioxys* (particularly in *Xerocoelioxys* and *Boreocoelioxys*) and even in some Old World *Liothyrapis*, but never in this combination. This group is the only North American subgenus with reduced carinae of the prothoracic tubercles, complete graduli on metasomal terga two and three, sixth metasomal sterna in females entire (as in Fig. 42B) or constricted (as in Fig. 45E, not notched as in Fig. 21), and foveal areas of metasomal terga two in males closely punctured. Italicized characters below most clearly differentiate the subgenus *Coelioxys* from others in North America.

A. Ocellar area moderately to closely punctured.

B. Preoccipital carina incomplete medially.

C. Mandible with inner surface simple (as in Figs. 45A, B).

D. *Prothoracic tubercle with carina distinct but not expanded into thin plate-like structure.*

E. Scutum moderately to closely punctured, fasciae usually indistinct.

F. Scutellum usually rounded posteriorly (Figs. 45C, D).

G. Axilla usually well produced (Figs. 45C, D).

H. Mesepisternum closely to contiguously punctured, no minute punctures.

I. *Gradular grooves complete on metasomal terga two and three.*

J. Female: fore coxal spine small, inconspicuous.

K. Female: *sixth metasomal sternum with margin entire* (as in Fig. 42B) or *constricted subapically* (as in Fig. 45E, F), not notched as in Figure 21.

L. Male: hypostomal area of gena with distinct excavation (as in Fig. 5).

M. Male: *foveal area of metasomal tergum two closely punctured.*

N. Male: fifth metasomal tergum with lateral spines present but not conspicuous.

O. Male: sixth metasomal tergum with dorsal spines long (as in Fig. 45G) or short (as in Fig. 45I).

P. Male: seventh metasomal tergum broadly rounded apically (Fig. 46A).

Q. Male: fourth metasomal sternum sub-

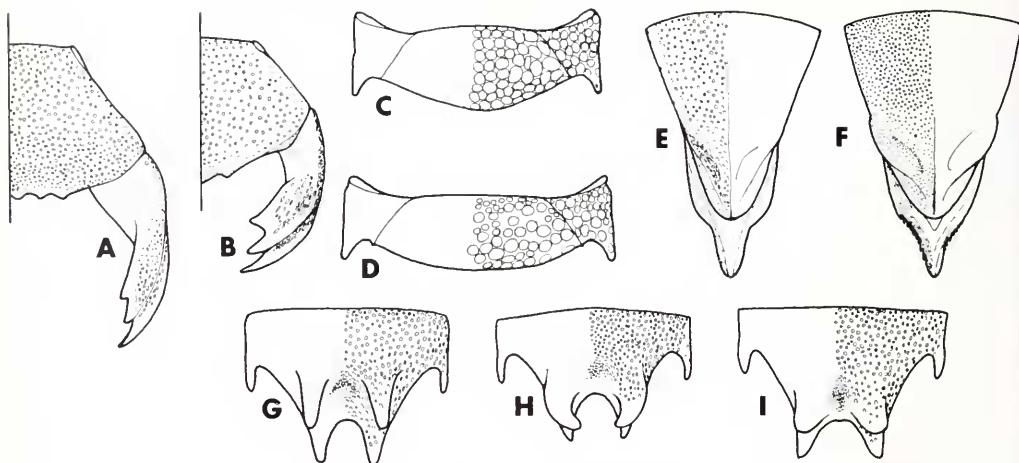


FIGURE 45. Parts of spp. of the subgenus *Coelioxys*. A-B, Left half of clypeus and mandible. A, *C. sodalis*; B, *C. serricaudata*. C-D, Scutellum and axillae. C, *C. sodalis*; D, *C. immaculata*. E-F, Sixth metasomal tergum and sternum of females. E, *C. sodalis*; F, *C. serricaudata*. G-I, Sixth metasomal tergum of males. G, *C. sodalis*; H, *C. serricaudata*; I, *C. immaculata*.

apically carinate, apex bidentate (as in Fig. 26B).

R. Male: seventh sternum represented by two small sclerites (as in Fig. 19D).

KEY TO FEMALES OF THE SUBGENUS *Coelioxys*

1. Clypeus strongly convex, in lateral view almost half the width of eye; ventral portion of rest of face convex *serricaudata*
Clypeus less convex, in lateral view much less than half the width of eye; ventral portion of rest of face flat or slightly rounded 2
2. Ocular hairs long (about 1.5 mm) *sodalis*
Ocular hairs medium or short (about 1.0 to 0.5 mm) 3
3. Sixth metasomal sternum not or little constricted subapically (Fig. 42 B) *mittelli*
Sixth metasomal sternum conspicuously constricted subapically 4
4. Clypeus slightly raised, shining, medio-apically depressed or flat *immaculata*
Clypeus not raised, slightly rounded vertically *hirsutissima*

KEY TO MALES OF THE SUBGENUS *Coelioxys*

1. Metasomal tergum six with dorsal spines curved inward, upper surfaces sloping ventrally from outer margin (Fig. 45 H) *serricaudata*

- Metasomal tergum six with dorsal spines directed posteriorly or slightly outward, upper surfaces not sloping 2
2. Ocular hairs long (about 0.17 mm) *sodalis*
Ocular hairs shorter (0.12-0.05 mm) 3
3. Excavation of hypostomal area appearing bare 4
Excavation at least half covered by short setae *hirsutissima*
4. Intero-cellular distance greater than ocellocipital distance; coast to coast distribution *mittelli*
Intero-cellular distance subequal to or slightly less than ocellocipital distance; distribution limited to southeastern United States *immaculata*

Coelioxys sodalis Cresson

Figures 45A, C, E, G; 46A-D; 47

Coelioxys quadridentata; Cresson, 1864, Proc. Entomol. Soc. Philadelphia 2: 409 (United States, Trenton Falls, misidentification); Hicks, 1926, Univ. Colorado Stud. 15:226 (Searching behavior, misidentification).

Coelioxys sodalis Cresson, 1878, Trans. Amer. Entomol. Soc. 7:99 (♂, New York, Colorado, type in the Academy of Natural Sciences of Philadelphia); Mitchell, 1962, North Carolina Agr.

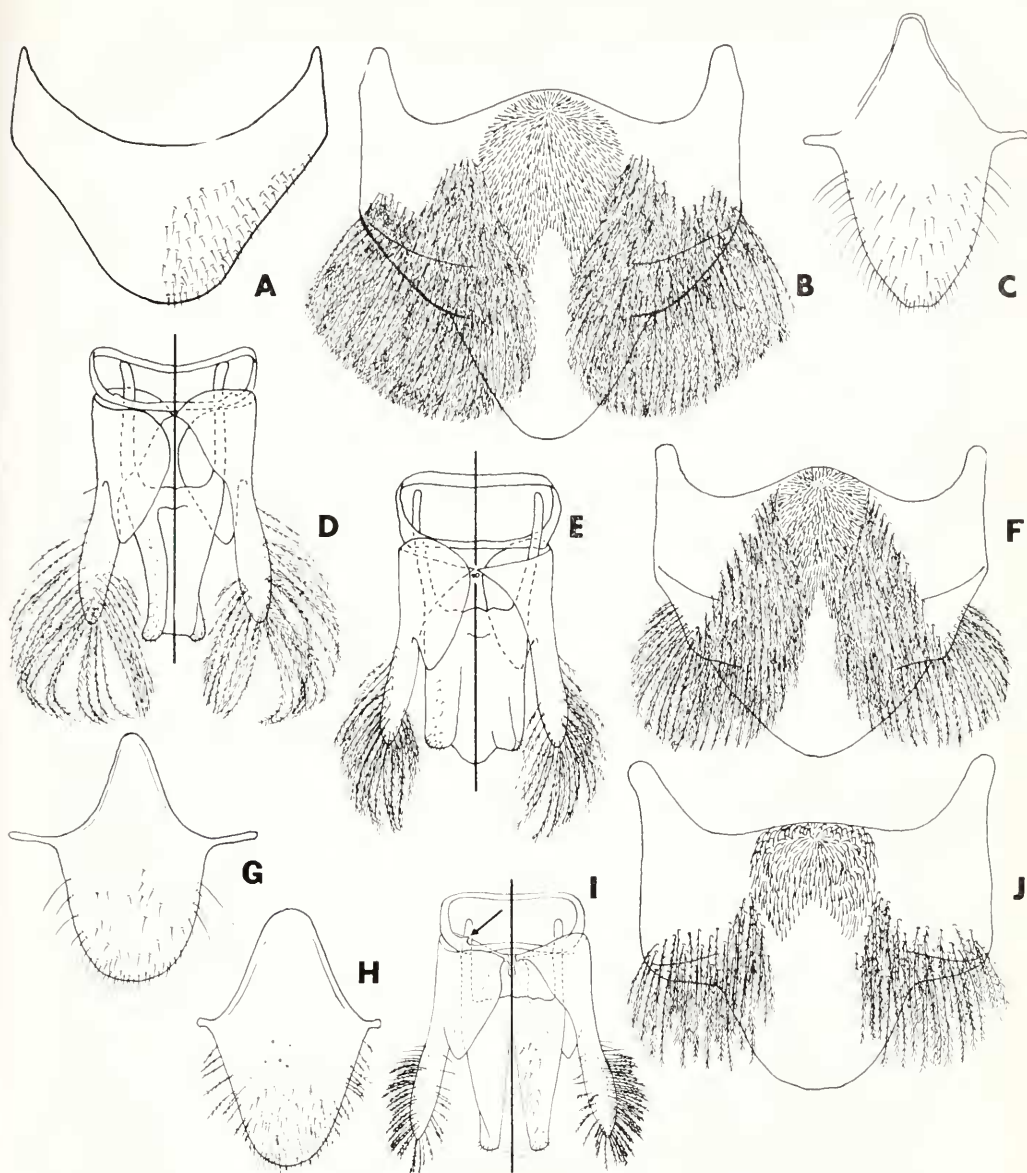


FIGURE 46. Hidden sclerites of males of the subgenus *Coelioxys*. A-D, *C. sodalis*. A, Seventh tergum; B, Sixth sternum; C, Eighth sternum; D, Genital armature. E, *C. hirsutissima*, genital armature. F-G, *C. immaculata*. F, Sixth sternum; G, Eighth sternum. H-I, *C. mitchelli*. H, Eighth sternum; I, Genital armature. J, *C. serricaudata*, sixth sternum.

Exp. Sta. Tech. Bull. 152:193, 195, 226 (Key, redescription, = *C. tristis*, = *C. ribis*).

Coelioxys ribis Cockerell, 1900, Can. Entomol. 32:297, 301, 308 (♂, New Mexico, key, type in the National Museum of Natural History); Graenicher,

1935, Ann. Entomol. Soc. Amer. 28: 300, 304 (Biology); Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:226 (= *C. sodalis*).

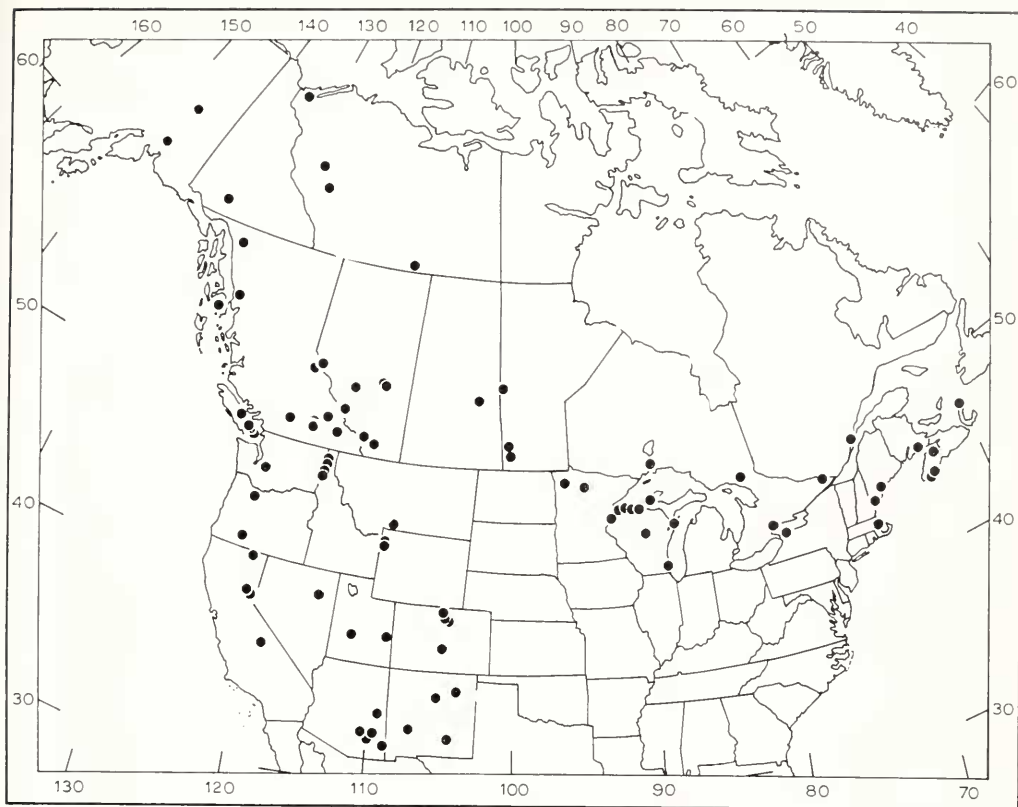
Coelioxys ribis var. *kincaidi* Cockerell, 1904, Ann. Mag. Nat. Hist. (7) 13:33 (♀, ♂, Washington, type in the Amer-

ican Museum of Natural History); Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:226 (= *C. sodalis*).

FEMALE. (1) Length 11-13 mm; (2) integument very finely rugulose, moderately shiny between punctures; black, antenna, legs, tegula, metasoma black to piceous; (3) pubescence white, pale ochraceous on face, mesosoma, golden on tarsi; (4) ocular hairs long (about 0.15 mm); (5) clypeus convex, almost hidden by appressed setae, longer, erect, scattered setae; margin with 6 small denticles (Fig. 45A); (6) clypeoantennal distance shorter than lateral margin of clypeus; (7) paraocular area almost hidden by setae up to 0.35 mm long; (8) rest of face rugose except for a small impunctate median area, closely punctured up to ocellar area; (9) clypeoantennal distance subequal to antennoocular distance, less than interantennal distance; (10) ocellar area closely punctate; (11) interocellar distance greater than ocellocipital distance, less than ocellocular distance; (12) vertex closely punctured; (13) gena narrower than eye, constricted below; ventral angle greater than 90° ; (14) hypostomal area of gena with setae subequal to or longer than those on disc; (15) mandible with short teeth (Fig. 45A); (16) scutum closely punctured; erect, slender setae on disc about 0.33 mm long; (17) lateral surface of mesepisternum closely punctured, with erect, slender setae about 0.35 mm long; (18) scutellum with posterior margin strongly rounded (Fig. 45C) or slightly produced, carina separating dorsal and posterior surfaces indistinct; (19) axilla sometimes less produced than shown in Figure 45C; (20) metanotal setae erect; (21) fore coxal spine small (about 0.08 mm), triangular, directed anteriorly; (22) terga 1-5 with apical fasciae less conspicuous than shown in Figure 21, punctured as in Figure 21 but with slightly smaller punctures; ter-

gum 6 elongate (Fig. 45E); (23) sterna 1 to basal portion of sternum 5 moderately punctured, apical portion of sternum 5, sternum 6 very closely punctured; sternum 6 constricted subapically (Fig. 45E).

MALE. (24) Length 8-12 mm; (25) integument as in female (2 above); (26) pubescence white, golden on tarsi; (27) ocular hairs long (about 0.15 mm); (28) clypeus hidden by setae about 0.6 mm long; surface rugose, shiny; margin as in female (5 above); (29) clypeoantennal distance as in female (6 above); (30) paraocular area almost hidden by setae up to 0.6 mm long; (31) rest of face closely punctured, almost hidden by setae up to 0.6 mm long; (32) clypeoantennal, antennoocular, interantennal distances as in female (9 above); (33) ocellar area closely punctate; (34) interocellar distance subequal to ocellocipital distance, less than ocellocular distance; (35) vertex closely punctured, sometimes with small, irregular, impunctate areas lateral to ocelli; (36) gena as in female (13 above); (37) hypostomal area of gena with distinct excavation (Fig. 5) covered with setae shorter than those on disc; (38-39) mandible, scutum as in female (15-16 above); (40) lateral surface of mesepisternum with setae about 0.45 mm long; (41-43) scutellum, axilla, metanotal setae as in female (18-20); (44) front coxal spine long (about 0.33 mm), narrow (about 0.12 mm) with setae on dorsal and ventral surfaces; rounded apically; directed anteriorly; (45) terga 1-5 with fasciae and punctures as in female (22 above); tergum 2 with postgradular area very closely punctured and rounded to densely punctured and slightly but broadly sunken laterally; tergum 6 with dorsal spines slender (Fig. 45G); tergum 7 slightly protuberant apically (Fig. 46A); (46) sterna 1-4 moderately punctured, inconspicuous seta in each puncture; (47) margin of sternum 4, sternum 5 as in Figure 26B except den-

FIGURE 47. Distribution of *Coelioxys sodalis*.

ticles of sternum 4 more rounded; sternum 6 with shoulders inconspicuous (Fig. 46B); sternum 7 represented by 2 small sclerites; sternum 8 with narrow base (Fig. 46C); gonocoxite with long setae, gonobase complete (Fig. 46D).

HOST RECORDS. Graenicher (1927) reared *Coelioxys sodalis* from nests of *Megachile melanophoea wootoni*. Medler (1968) reared *C. sodalis* from the cells of *M. texana*. Hobbs (1968) reared *C. sodalis* from a third host bee, *M. rotundata*.

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys sodalis*, like *C. funeraria* and *C. moesta*, ranges from Alaska to high altitudes in Arizona and eastward in the north to Nova Scotia (Fig. 47).

This bee is in flight at least from April 17 (Arizona) and June 5 (Yukon Territory) to September 8 (Alberta).

HABITAT. *Coelioxys sodalis* has been collected mainly from areas classified as coniferous forests, although it does range down into sagebrush steppe (*Artemisia*, *Agropyron*) in the northwestern United States. In Canada it has been collected in the ecotone between tundra and coniferous forest, in the boreal forest, in the coastal or moist coniferous forest, and in coniferous and deciduous forest combinations in the east. In the Southwest, *C. sodalis* is associated with various coniferous forests dominated mainly by pine (*Pinus*).

GEOGRAPHIC VARIATION. Specimens of *Coelioxys sodalis* from the southern part of its range tend to have more distinct setal fasciae. In addition, the foveal area on the second metasomal tergum of males tends to be more closely punctured and very slightly and broadly

sunken in males from the Southwest. Western specimens closely resemble specimens of the Old World *Coelioxys quadri-dentata* in that western specimens of *C. sodalis* are more coarsely punctured.

COMPARATIVE COMMENTS. *Coelioxys sodalis* is a fairly large, dark bee which resembles *C. funeraria* and dark specimens of *C. rufitarsis*. Females of *C. sodalis* differ from the latter two species by the unnotched sixth metasomal sternum. Males of *C. sodalis* differ from *C. funeraria* and *C. rufitarsis* by the lack of a distinct fovea on the second metasomal tergum.

Coelioxys hirsutissima Cockerell
Figures 46E, 48

Coelioxys hirsutissima Cockerell, 1912, Can. Entomol. 44:168-169 (♂, California, key, type in the American Museum of Natural History).

FEMALE. Agrees with description and figures of *Coelioxys sodalis* except as follows: (1) Length 9-12 mm; (2) integument black; antenna, venter of metasoma black to piceous; mandible piceous to rufous; legs, tegula, subapical portion of 6th tergum piceous to ferruginous; (3) pubescence white, white to pale ochreous on mesosoma, golden on tarsi; (4) ocular hairs medium length (about 0.8 mm); (5) clypeus visible to almost hidden by short, appressed setae; slightly convex, margin with 3-5 small denticles; (14) hypostomal area of gena with setae shorter than those on rest of gena; (16) scutum closely punctured anteriorly and laterally, rest moderately to closely punctured; erect setae inconspicuous, about 0.2 mm long; (20) some metanotal setae appressed medially; (22) terga 1-5 with apical fasciae as or less conspicuous than shown in Figure 21; (23) sternum 6 with portion distal to constriction 2/3-1/2 as long as shown in Figure 45E.

MALE. Agrees with description and figures of *Coelioxys sodalis* except as follows: (24) Length 8-10 mm; (25) integument as in female (2 above); (28) clypeus hidden by setae about 0.45 mm long, margin as in female (5 above); (30) paraocular area hidden by setae up to 0.45 mm long; (31) rest of face almost hidden by setae up to 0.45 mm long; (35) vertex moderately punctured; (37) excavation of hypostomal area of gena covered anteriorly or completely by setae shorter than those on gena; (39) scutum as in female (16 above); (40) lateral surface of mesepisternum with setae about 0.35 mm long; (45) terga 1-5 with fasciae as in female (22 above); (47) margin of sternum 4, sternum 5 as in Fig. 26B; sternum 6 as in Fig. 46B, apical margin rounder (as in Fig. 46F); gonocoxites blunter than shown in Fig. 46D, gonobase simple (Fig. 46E).

DISTRIBUTION AND SEASON OF FLIGHT. This bee ranges from northern California southeastward into Texas (Fig. 48) and is in flight at least from March 15 (Texas) to July 16 (California).

HABITAT. *Coelioxys hirsutissima* ranges from areas classified as mixed coniferous forest (*Abies*, *Pinus*, *Pseudotsuga*), red fir forest (*Abies*), and oak-juniper woodland (*Quercus*, *Juniperus*) to areas classified as chaparral (*Adenostoma*, *Arctostaphylos*, *Ceanothus*), and coastal sagebrush (*Salvia*, *Eriogonum*) and into areas classified as California steppe (*Stipa*), creosote bush-bur sage (*Larrea*, *Franseria*), grama-tobosa prairie and shrubsteppe (*Bouteloua*, *Hilaria*, *Larrea*), sagebush steppe (*Artemisia*, *Agropyron*), and trans-Pecos shrub savana (*Flourensia*, *Larrea*, also with *Juniperus*).

COMPARATIVE COMMENTS. *Coelioxys hirsutissima* resembles *C. sodalis* and *C. immaculata* closely, but females differ from *C. sodalis* by shorter ocular hairs and brighter coloration of the legs and from *C. immaculata* by the flat or

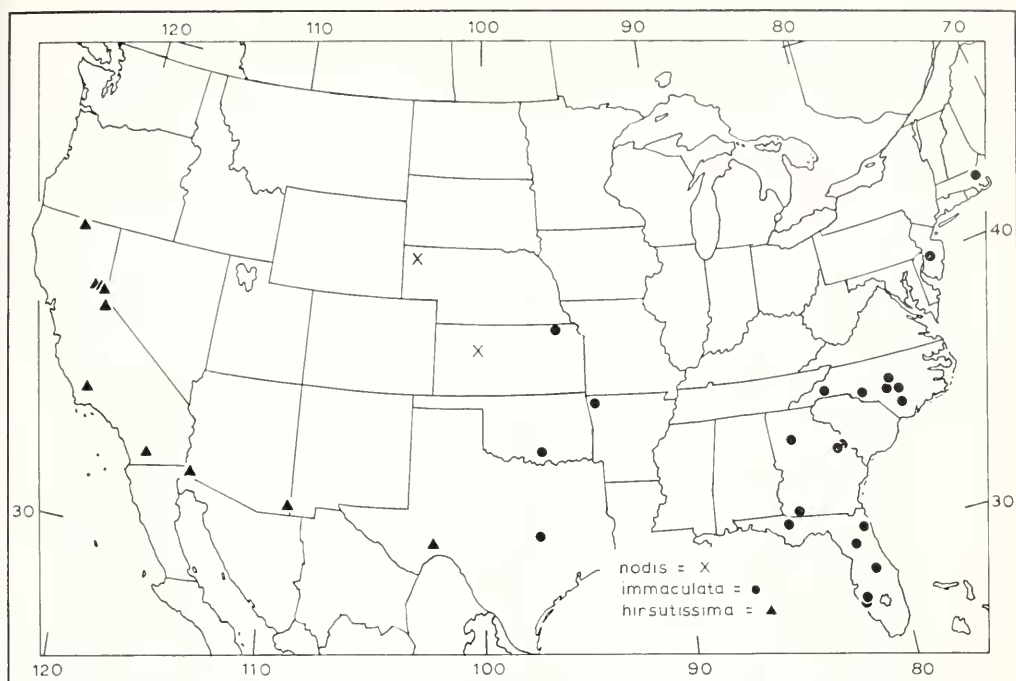


FIGURE 48. Distributions of *Coelioxys hirsutissima* (Δ), *C. immaculata* (o), and *C. nodis* (X).

slightly rounded clypeus (slightly raised in *C. immaculata*). Males of *C. hirsutissima* differ from males of *C. sodalis* by shorter ocular hairs and brighter coloration of the legs and from males of *immaculata* by pubescence on the excavation of the hypostomal area of the gena (almost bare in *C. immaculata*).

Coelioxys immaculata Cockerell

Figures 45D, I, 46F-G, 48

Coelioxys immaculata Cockerell, 1912, Can. Entomol. 44:165 (δ , Indiana, type in the American Museum of Natural History).

Coelioxys sculptifrons Crawford, 1914, Ann. Entomol. Soc. Amer. 7:153 (η , New York, type # 18220 in the National Museum of Natural History); Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:210 (= *C. immaculata*).

FEMALE. Agrees with description

and figures of *Coelioxys sodalis* except as follows: (1) Length 10-13 mm; (2) integument black; antenna black to rufous; legs piceous to ferruginous apically; tegula ferruginous; (4) ocular hairs medium (about 0.08 mm long); (5) clypeus as in *C. sodalis* to bare, shining; raised, medio-apically flat or slightly depressed; margin with 5 small denticles; (9) clypeoantennal distance slightly greater than antennocular distance, less than interantennal distance; (10) ocellar area moderately to closely punctured; (11) interocellar slightly greater than ocellocipital distance, less than ocellocular distance; (12) vertex moderately punctured; (13) gena with ventral angle less than 90° ; (16) scutum closely punctured anteriorly, posteriorly with 2 submedian slightly swollen, sparsely punctured areas; (17) lateral surface of mesepisternum contiguously punctured; erect slender setae about 0.4 mm long; (18) scutellum with posterior margin broadly rounded (Fig. 45D); (23) sternum 6 with

portion beyond constriction $2/3$ to $1/2$ as long as shown in Figure 45E.

MALE. Agrees with description and figures of *Coelioxys sodalis* except as follows: (24) Length 9-11 mm; (25) integument as in female (2 above), venter of metasoma black to piceous; (26) pubescence as in female (3 above); (27) ocular hairs long (about 0.12 mm); (28) clypeus hidden by setae about 0.45 mm long; margin as in female (5 above); (30) paraocular area hidden by setae about 0.45 mm long; (31) rest of face with setae about 0.45 mm long; (32) clypeoantennal, antennocular, interantennal distances as in female (9 above); (33) ocellar area shallowly punctured by large punctures; (37) hypostomal area of gena with posterior portion bare; (39) scutum as in female (16 above), submedian swollen areas moderately punctured; (41) scutellum slightly more rounded posteriorly than shown in Figure 45D; (43) axilla as in Figure 45C; (45) tergum 6 with dorsal spines blunt (Fig. 45I); (47) margin of sternum 4, sternum 5 as in Figure 26B; sternum 6 with thin apical portion broad (Fig. 46F); sternum 8 broad apically (Fig. 46G).

DISTRIBUTION AND SEASON OF FLIGHT. This bee ranges throughout the eastern United States (Fig. 48) and is in flight at least from March 30 (Florida) to July 14 (Massachusetts).

HABITAT. *Coelioxys immaculata* has been collected from areas classified as bluestem prairie (*Andropogon*, *Panicum*, *Sorghastrum*) and cross timbers (*Quercus*, *Andropogon*) in the western portion of its range. Further east it has been taken from areas classified as various deciduous forests such as Appalachian oak forest (*Quercus*), oak-hickory forest (*Carya*), north-eastern oak-pine forest (*Pinus*), oak-hickory-pine forest, southern mixed forest (*Fagus*, *Liquidambar*, *Magnolia*, *Pinus*,

Quercus), and southern floodplain forest (*Quercus*, *Nyssa*, *Taxodium*).

COMPARATIVE COMMENTS. *Coelioxys immaculata* closely resembles *C. sodalis* and *C. hirsutissima* but differs from both by submedian areas of the scutum which are usually conspicuously less closely punctured than the surrounding areas. In females the clypeus is slightly raised and indented medioapically (flat or slightly convex in *C. sodalis* and *C. hirsutissima*).

Coelioxys mitchelli new species

Figures 42B, 43, 46H-I

Coelioxys piercei; Mitchell, 1962, North Carolina Agr. Exp. Sta. Tech. Bull. 152:217 (misidentification).

FEMALE. Agrees with description and figures of *Coelioxys edita* except as follows: (1) Length 9-10 mm; (2) integument black; antenna, legs proximal to tibia piceous; tegula, legs distal to femur, apical margins of sterna 5, 6 piceous to fulvous; (3) pubescence white; white to pale yellow on face, dorsal mesosoma; golden on tarsi; (4) ocular hairs short (about 0.06 mm long); (5) clypeus convex, surface with scattered slender setae 0.05-0.1 mm long; margin with three distinct teeth almost hidden by fringe of slender setae 0.3 mm wide; (7) paraocular area hidden by setae about 0.3 mm long; (8) rest of face visible to hidden; setal length about 0.25 mm around antenna to about 0.09 mm medially; (10) ocellar area closely punctured; (12) vertex moderately punctured (Fig. 42B); (15) mandible resembles Figure 36B; (16) scutum closely punctured medially, contiguously punctured laterally (Fig. 42B); (17) lateral surface of mesepisternum moderately to closely punctured with large punctures; fasciae variable; surface bare to almost hidden by slender setae about 0.3 mm long; (18) scutellum slightly curved pos-

teriorly (Fig. 42B) to broadly rounded; (19) axilla not carinate (Fig. 42B); (21) fore coxal spine about 0.09 mm long, directed anteroventrally; (22) basal fascia of tergum 1 as or more conspicuous than shown in Figure 42B; tergum 2 with foveal area not modified; (23) sterna 1-5 fasciate apically (medially on sternum 1 and fascia complete on sternum 5); sternum 1 medially closely punctured; sternum 6 with lateral margin entire (Fig. 42B).

MALE. Agrees with description and figures of *Coelioxys edita* except as follows: (24) Length 9.5-10 mm; (25) integument as in female (2 above); (26) pubescence as in female (3 above); (27) ocular hairs medium length (0.12 mm); (28) clypeal margin as in female (5 above); (30) paraocular area hidden by setae about 0.45 mm long; (31) rest of face with setae about 0.45 mm long; (32) clypeoantennal distance less than interantennal distance, greater than antennocular distance; (33) ocellar area as in female (10 above); (34) interocellar distance greater than ocellocipital distance, less than ocellocular distance; (35) vertex as in female (12 above); (37) posterior portion of excavation of hypostomal area of gena almost bare; (38) mandibles as in female (15 above); (39) scutum without fasciae; (40-42) mesepisternum as in female (17-19 above); (43) metanotum with few appressed setae medially; (45) gradular grooves of terga 4-6 with conspicuous fasciae; tergum 6 resembles Figure 39K; (46) fasciae complete on sterna 1-4; (47) margin of sternum 4, sternum 5 as in Figure 19B; sternum 6 as in Figure 26C; sternum 8 as in Figure 46H; genital armature with small projection on gonobase (arrow on Fig. 46I).

DISTRIBUTION AND SEASON OF FLIGHT. *Coelioxys mitchelli* ranges from coast to coast (Fig. 43).

This bee is in flight from at least April

1 (Florida) and April 24 (southern California) to June 22 (Nevada).

HABITAT. In the East, *Coelioxys mitchelli* has been collected in areas classified as oak-hickory-pine (*Quercus*, *Carya*, *Pinus*) and southern mixed (*Fagus*, *Liquidambar*, *Magnolia*, *Pinus*, *Quercus*) forests. In Kansas it was taken from blue-stem-grama prairie (*Andropogon*, *Bouteloua*). Further west *C. mitchelli* was taken from areas classified as sagebrush steppe (*Artemisia*, *Agropyron*), creosote bush-bur sage (*Larrea*, *Franseria*), creosote bush, and saltbush-greasewood (*Atriplex*, *Sarcobatus*) vegetation types.

GEOGRAPHIC VARIATION. Western specimens of *Coelioxys mitchelli* in general have lighter colored tegulae and legs as well as denser, more conspicuous pubescence on the face, lateral surface of the mesepisternum, and metasoma.

COMPARATIVE COMMENTS. *Coelioxys mitchelli* closely resembles *C. mesae* (for this reason the description was compared with *C. edita* rather than *C. sodalis*) but differs by its smaller size, shinier integument, and lesser quantity of appressed setae on the scutum, posterior surface of scutellum, and on the metanotum. Western specimens of *C. mitchelli* possess ferruginous or fulvous tegulae and legs whereas those of *C. mesae* are black or piceous.

TYPES. Holotype female, Raleigh, North Carolina, May 23, 1959 (T. B. Mitchell). Allotype male, Wake Co., N.C., May 22, 1960, on *Oenothera* (T. B. Mitchell), both deposited in the North Carolina State University Museum. Paratypes females, Raleigh, N.C., May 1930, May 19, 1932, May 9, 1935 (T. B. Mitchell), May 23, 1959, May 18, 1922, May 17, 1951, May 25, 1933, last three of *Oenothera*, Wake Co., N.C., May 21, 1960, May 26, 1960; males, 3 from Tallahassee, Florida, April 1, 1944 (R. & G. Bohart), Raleigh, N.C., May 23, 1922, on *Oenothera*

(T. B. Mitchell). Paratypes are deposited in the collections of the North Carolina State University Museum, Utah State University, the National Museum of Natural History, Snow Entomological Museum, University of Kansas, and the Florida State Collection of Arthropods, Division of Plant Industry.

This species is named in honor of Professor emeritus T. B. Mitchell of the North Carolina State University.

Coelioxys serricaudata, new species

Figures 45B, F, H, 46J, 49

FEMALE. Agrees with description and figures of *Coelioxys sodalis* except as follows: (1) Length 10-12 mm; (2) integument black; antenna, legs, tegula, venter of metasoma black to piceous; (3) pubescence white; white to golden on head, mesosoma; golden on tarsi; (4) ocular hairs medium (0.08 mm long); (5) clypeus with slender, inconspicuous setae; strongly convex; closely punctured, shiny; margin with 3-5 denticles (Fig. 45B); (8) ventral portion of rest of face convex; (9) clypeoantennal distance greater than antennocular distance, shorter than interantennal distance; (14) hypostomal area of gena with setae subequal or shorter than those on disc; (15) mandible with hump on outer surface (Fig. 45B); (17) lateral surface of the mesepisternum with slender, prostrate setae up to 0.45 mm long; (18) scutellum similar to Figure 45D; (19) axilla as in Figure 37D; (20) metanotum with setae prostrate medially; (22) terga 1-5 with apical fasciae similar to or more conspicuous than those shown in Figure 21; uniformly, closely punctured with smaller punctures than shown in Figure 21; tergum 6 very closely punctured (Fig. 45F); (23) sterna 1 to basal portion of 5 closely, uniformly punctured; most of sternum 5, 6 very closely punctured; sternum 6 with subapical margin

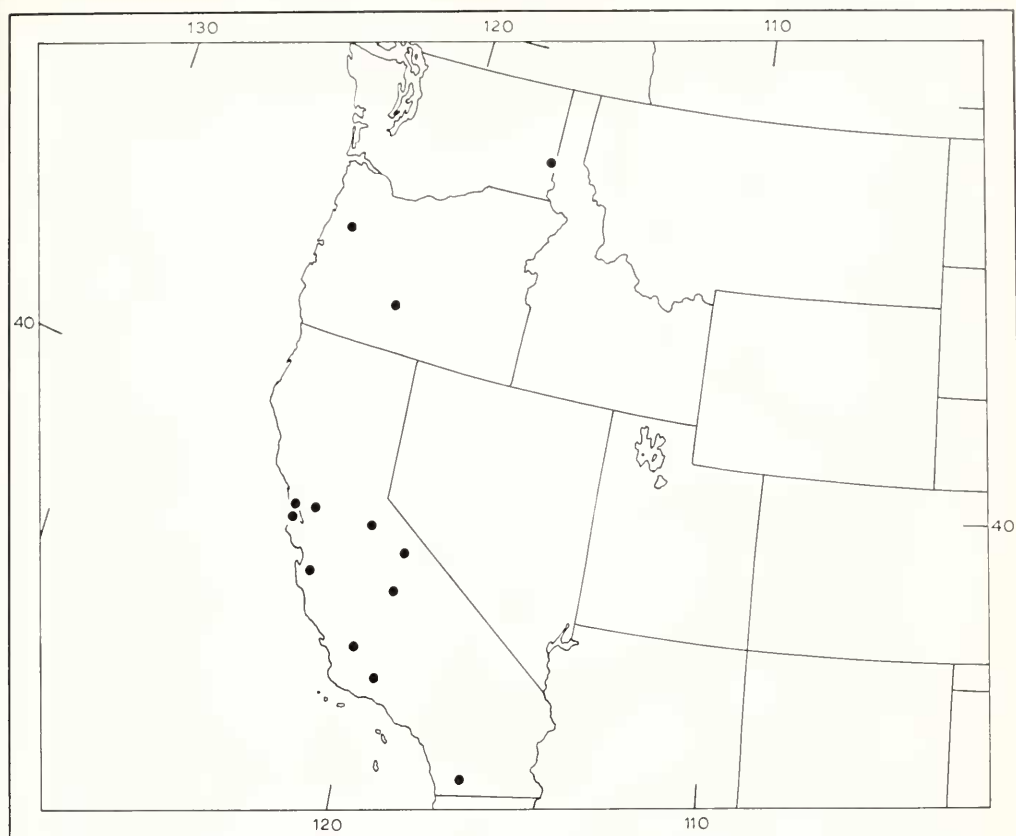
serrate (Fig. 45F, serrations visible in silhouette against light source).

MALE. Agrees with description and figures of *Coelioxys sodalis* except as follows: (24) Length 9-11 mm; (25-26) integument, pubescence as in female (2-3 above); (28) margin of clypeus as in female (5 above); (32) clypeoantennal, antennocular, interantennal distances as in female (9 above); (35) vertex closely punctured; (38) mandible as in female (15 above); (41-42) scutellum, axilla as in female (18-19 above); (45) terga 1-5 with fasciae and punctures as in female (22 above); tergum 6 with dorsal spines curved and sloped medially (Fig. 45H); (47) margin of sternum 4 as in Fig. 39O, lacking longitudinal carinae; sternum 6 with shoulders distinct (Fig. 46J); gonocoxites with setae 2/3 length shown in Fig. 46E.

DISTRIBUTION AND SEASON OF FLIGHT. This bee has been collected from May 5 to July 6 in the Pacific coast states (Fig. 49).

HABITAT. *Coelioxys serricaudata* has been taken from areas classified as mixed conifer forest (*Abies*, *Pinus*, *Pseudotsuga*), lodgepole pine-subalpine forest (*Pinus*, *Tsuga*), ponderosa pine shrub forest, and California mixed evergreen forest (*Quercus*, *Arbutus*, *Pseudotsuga*); areas classified as open grassland such as fescue-oat-grass (*Festuca*, *Danthonia*), fescue-wheat-grass (*Agropyron*), California steppe (*Stipa*), tule marshes (*Scirpus*, *Typha*), and alpine meadows and barrens (*Agrostis*, *Carex*, *Festuca*, *Poa*).

COMPARATIVE COMMENTS. Females of *Coelioxys serricaudata* are slender, dark bees which resemble *C. moesta*, but differ from all other North American *Coelioxys* by the strongly convex clypeus and serrated margin of the sixth metasomal sternum (Fig. 45F). Males of *C. serricaudata* are darker than most *Coelioxys* males and differ from all

FIGURE 49. Distribution of *Coelioxys serricaudata*.

other North American *Coelioxys* by the dorsal spines of the sixth metasomal tergum which are strongly curved and sloped medially.

TYPES. Holotype female, Hastings Nat. Hist. Reservation, Santa Lucia Mts., Jamesburg, Monterey Co., California, 1900-2700 ft., June 12, 1938 (C. D. Michener), deposited in Snow Entomological Museum, the University of Kansas. Paratypes females, one, Prospect, Oregon, June 20, 1924 (C. L. Fox); one, Antelope Mt. L. O., Grant Co., Oregon, El. 6500 ft., August 7, 1941 (M. & R. E. Rieder); one, Corvallis, Oregon, July 1, 1910 (J. C. Bridwell); one, Palouse, Washington, June 26, 1961 (R. W. Dawson); the remaining paratypes are from California: one, Tanbark Flat, Los Angeles Co., June 20, 1956

(R. C. Bechtel); one, Twaine-Harte, Tuolumne Co., 4000 ft., July 1937, *Grindelia* sp. (F. E. Blaisdell); one, Chile Bar, Eldorado Co., July 5, 1948 (C. Chan); Redwood City, San Mateo Co., June 10, 1961 (P. H. Arnaud, Jr.); one, 16 mi. E. Glenville, Kern Co., June 25, 1961 (R. L. Macdonald); one, Mormon Bar, 2 mi. S., Mariposa Co., June 16, 1959 (G. I. Stage); one, Miguel Meadows, Yosemite National Park, Elev. 5200, July 6, 1940 (E. G. Linsley); one, Pine Flat, Tulare Co., June 14, 1961 (G. I. Stage, R. R. Snelling); one, Ryan Creek, Mendocino Co., June 27, 1954, *Godetia amoena* (P. D. Hurd); one, Nipinnawasee, Madera Co., July 4, 1960 (G. I. Stage, R. R. Snelling); one, Santa Margarita, 6 mi. N. E., S. L. Obispo Co., June 22, 1958 (E. G. Linsley); two, Ar-

royo Seco, Monterey Co., May 2, 1959 (Don Burdock), May 5, 1956 (Dave Ribble); two, California Hot Springs, Tulare Co., June 4, 1934 (E. C. VanDyke), (E. R. Leach); five, Antioch, Contra Costa Co., two, May 6, 1939, one, May 16, 1936 (M. Cazier), one, April 25, 1936 (M. Cazier), one, June 23, 1957 (G. I. Stage). Paratypes are in collections of the California Academy of Sciences; the University of California at Berkeley and Davis; the Los Angeles County Museum; the National Natural History Museum; San Jose State College; Utah State University; G. I. Stage, the University of Connecticut; and P. H. Timberlake, the University of California, Riverside.

The specific name refers to the serrate margin of the apical sternum of the female.

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